DIGI-PAD™ 5A

USER'S MANUAL

GTCO Corporation

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Warranty

GTCO Corporation warrants that all its products are free from defects in workmanship and materials for a period of ninety (90) days from the date of delivery. GTCO's sole obligation under this warranty shall be limited to correcting, without charge, that which upon examination by GTCO, is disclosed to have been originally defective. All returned items must be shipped prepaid and tagged with unit serial number and failure symptoms noted. Before such shipment, GTCO's Customer Service Department must be contacted to obtain a return authorization (RA) number and shipping instructions. If GTCO determines that the unit is not defective within the terms of this warranty, the buyer shall pay the cost of all freight and repairs at the then prevailing GTCO repair rates.

This warranty does not apply to any GTCO Corporation equipment that has been subject to neglect, misuse, accident, improper installation or improper maintenance.

GTCO shall not be liable for loss or damages other than above stated, whether caused directly or indirectly by this product.

This warranty supersedes and is in lieu of all other warranties expressed or implied, including the warranty of merchantability. No other liabilities may be assumed unless expressly authorized in writing by GTCO Corporation.

Warning

Digi-Pad Models DP5A-1111A and DP5A-1117A have been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only computers or computer peripherals certified to comply with the Class B limits should be attached to these models. Interconnection between these Digi-Pad models and other devices must be made with shielded cables. Operation with non-certified devices is likely to result in interference to radio and TV reception. See *Radio and Television Interference* in Chapter 7 for specific instructions.

All other Digi-Pad models are verified to comply with the limits for a Class A computing device, pursuant to Subpart J of Part 15 of FCC rules. These models are for use in non-residential environments.

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How To Use This Manual

Your Digi-Pad may be part of a complete graphic system you purchased, or you may have purchased it to use with particular graphic hardware or software. If so, the manuals for those other products may contain specific instructions on how to set up the Digi-Pad. If they do, then you don't need to read the entire Digi-Pad User's Manual. Instead, read Chapter 1, Getting To Know Your Digi-Pad, and Chapter 4, Using Your Digi-Pad, and follow the instructions provided in the other manuals.

If you are developing your own graphic system or application software, you will need to read this manual thoroughly. Digi-Pads offer extensive capabilities, and taking full advantage of them requires a detailed understanding of those features. In short, you need to know what Digi-Pads can do and how to make them do it.

Different Digi-Pad Configurations

There are many items in GTCO's Digi-Pad product line. The biggest difference between Digi-Pad models is the size and appearance of their tablets. Aside from that, all Digi-Pads use the same accessories and internal electronics. This means that all Digi-Pads function in the same way, and have the same interconnections, switch settings, and data formats. Should your application needs change, you can substitute another Digi-Pad size without changes to other parts of your system.

This manual covers all Digi-Pad tablet sizes and accessories. Since it is comprehensive, it contains details that won't apply to your particular configuration.

How This Manual Is Organized

The Digi-Pad User's Manual shows you how to install and use your Digi-Pad graphic digitizer. The manual is arranged so you can find the information you need quickly and easily. It follows a logical progression from unpacking, to setting up, to using your Digi-Pad. Here is a summary of what you will find in this manual:

Chapter 1, *Getting To Know The Digi-Pad*, explains what a digitizer does, describes how to unpack and identify the Digi-Pad and its parts, and shows you how to connect the parts together.

Chapter 2, *Making Communication Choices*, explains interfacing in general, describes the communication options available, and helps you select the configuration needed for your system.

Chapter 3, *Making Operating Choices*, describes the various operating selections available and shows you how to set the Digi-Pad's switches to get the combination you want.

Chapter 4, *Using The Digi-Pad*, shows you how to operate your digitizer and how to effectively use its stylus and cursors.

Chapter 5, *Using Remote Commands*, lists commands that can be sent to the digitizer and describes what each one does to change the operating characteristics.

Chapter 6, *Using Digi-Pad Options*, discusses three Digi-Pad options—4D, pressure pen and GPIB interface—and shows you how to use them.

Chapter 7, *Digi-Pad Reference*, provides additional technical details about the Digi-Pad and has a troubleshooting guide to help you determine whether your Digi-Pad has an operating problem.

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Chapter 1

Getting To Know The Digi-Pad

This chapter begins by describing what a Digi-Pad does and how it fits into a system. Then it tells you how to unpack your Digi-Pad, and helps you identify the major parts. If you purchased a pedestal for a large Digi-Pad tablet, there are instructions here for mounting the tablet on it. Next, you see how to attach Digi-Pad accessories to the controller. Finally, you learn to the basics of Digi-Pad switches, to prepare you for making the operating selections discussed in the following chapters.

What The Digi-Pad Does

Digi-Pads belong to a class of computer input devices called graphic digitizers. A graphic digitizer typically consists of a handheld stylus (or alternately, a cursor) and an electronic tablet work surface. Graphic digitizers convert the position of the stylus into data for computer processing. A digitizer usually generates data in the form of an XY coordinate pair, similar to the pair of numbers describing the location of a point on a graph. (If you want more details about how the Digi-Pad creates coordinates, see *General Theory of Operation* in Chapter 7.)

A computer keyboard is an input device for alphanumeric data (text). Likewise, a digitizer is an input device for graphic data. By itself, a keyboard is not of much use. A keyboard becomes useful when it is sending keystrokes to an application program, such as a word processor or spreadsheet. Similarly, a digitizer works with an application program that needs position information to do useful things.

What sorts of things can a digitizer be used for? Here are some examples:

- Moving a pointer on a screen
- Creating and manipulating elements in a graphic composition
- Tracing a drawing placed on the tablet to create a copy inside the computer
- Selecting commands or functions from a menu of such items

Digi-Pads In Systems

Digi-Pads are frequently used as general purpose input devices in computer-based graphic systems. In these systems, Digi-Pads do all of the things listed above. How you use your Digi-Pad depends on the particular hardware and software that you use it with. In your system, the Digi-Pad may do one or more of the functions listed above, or it may do other things as determined by the application program.

Figure 1.1 shows how a Digi-Pad operates in a small graphic system. Note that steps 1 and 2 in the figure are virtually instantaneous.

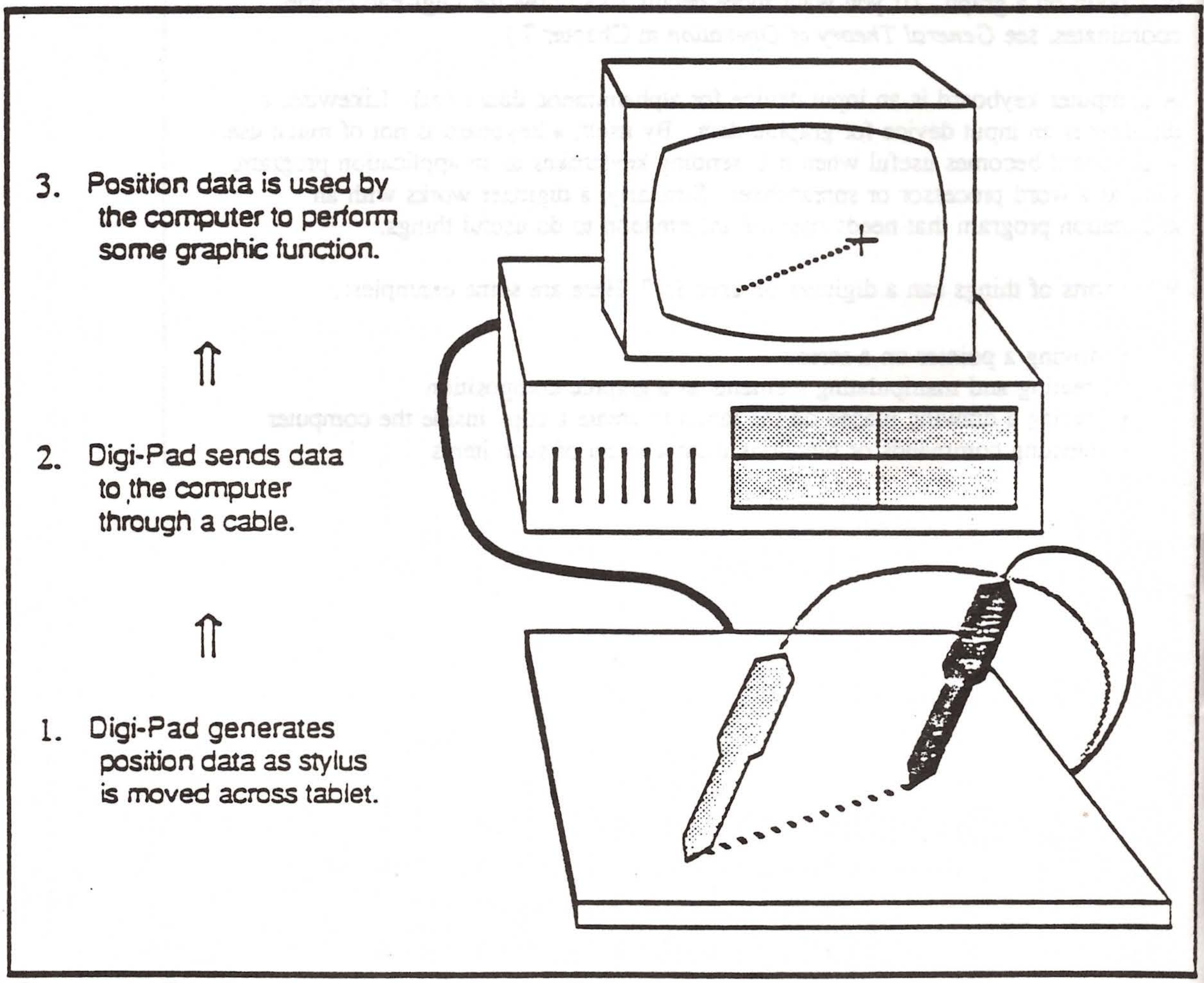

3. Position data is used by the computer to perform some graphic function.
⇑
2. Digi-Pad sends data to the computer through a cable.
⇑
1. Digi-Pad generates position data as stylus is moved across tablet.

Figure 1.1 - The Digi-Pad In A Small Graphic System

Unpacking The Digi-Pad

The packing materials used to ship the Digi-Pad depend on what model you ordered. Small models are shipped in cushioned cardboard cartons. Large tablets are shipped in wood crates or large cardboard cartons, and their accessories are shipped separtately in small cardboard cartons.

To open small cardboard cartons, cut the tape which holds them closed. Do not cut deeply into the box, as this could cause damage to the contents.

Opening Large Cardboard Cartons

To open large cardboard cartons containing large Digi-Pad tablets, you will need two things:

- A pair of tinsnips
- Someone to help you move the carton

Here is how to open a large Digi-Pad carton:

1. Find the side of the carton on which the steel bands have clips—this is the top of the carton.

2. Place the carton on the floor with the top facing up.

3. Using the tin snips, cut the steel bands. CAUTION: The bands may snap outward. Stay clear when cutting them.

4. Lift the cardboard cover from the carton. Note: you now see the top of the tablet.

Opening Wood Crates

Opening wood crates requires three things:

- A claw hammer or crowbar
- A pair of tinsnips
- Someone to help you move the crate

Here is how to open a Digi-Pad crate:

1. Find the side of the crate on which the steel bands have clips—this is the top of the crate.

2. Place the crate flat on the floor with the top facing up.

3. Using the tin snips, cut the steel bands. CAUTION: The bands may snap outward. Stay clear when cutting them.

4. Using the hammer or crowbar, pry the cover from the crate.

5. Using the hammer or crowbar, remove the nails that secure the wood beams over the tablet. Remove the wood beams. Note: you now see the bottom of the tablet.

Identifying The Parts

Before going further, take a moment to identify the items you have. You will need to know what each piece is named so that you can follow the instructions later in this manual. Also, you must know where to find connectors and the configuration switches.

Tablets

Let's start with the tablet. How it looks will depend on what size tablet you have. Figures 1.2 and 1.3 give you a general idea of what small and large Digi-Pad tablets look like.

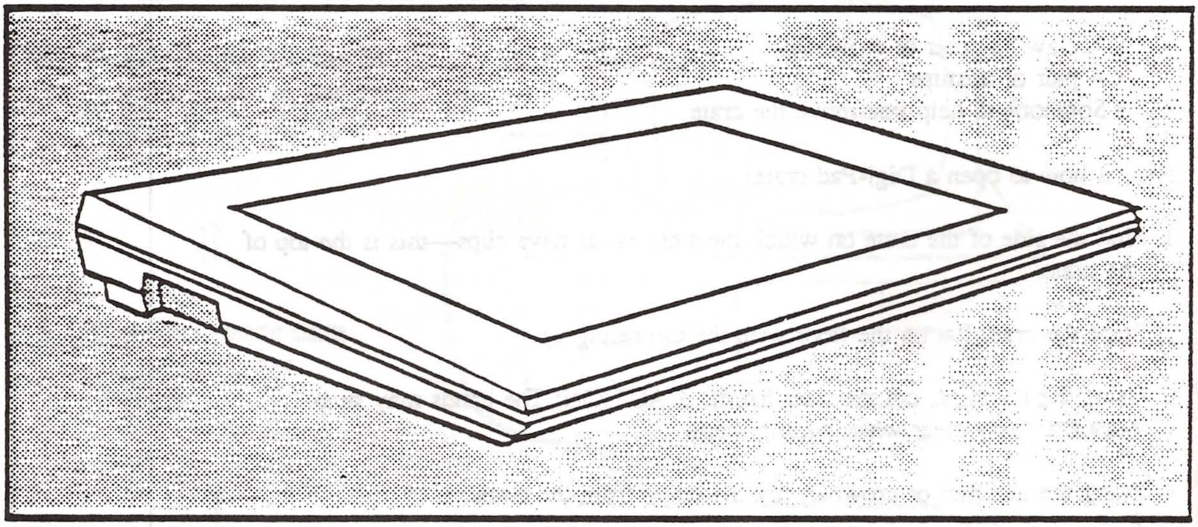


Figure 1.2a - Typical Small Digi-Pad

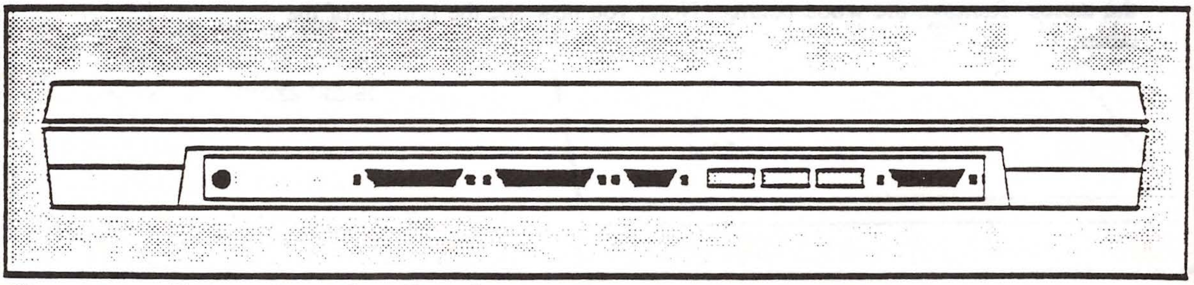


Figure 1.2b - Typical Small Digi-Pad, Rear View

Controller

The electronics board inside the Digi-Pad is called the controller. Small Digi-Pads have the controller mounted inside the tablet housing. The A series large tablets have the controller mounted underneath the tablet at the rear. The L series large tablets do not have the controller physically attached to the tablet. Instead, it is in a separate metal chassis that sits near the tablet.

Take a close look at the rear panel on the Digi-Pad. The rear panel has the connectors that the Digi-Pad uses to communicate with other devices, and the switches which govern the Digi-Pad's operation. Figure 1.4 shows where these items are.

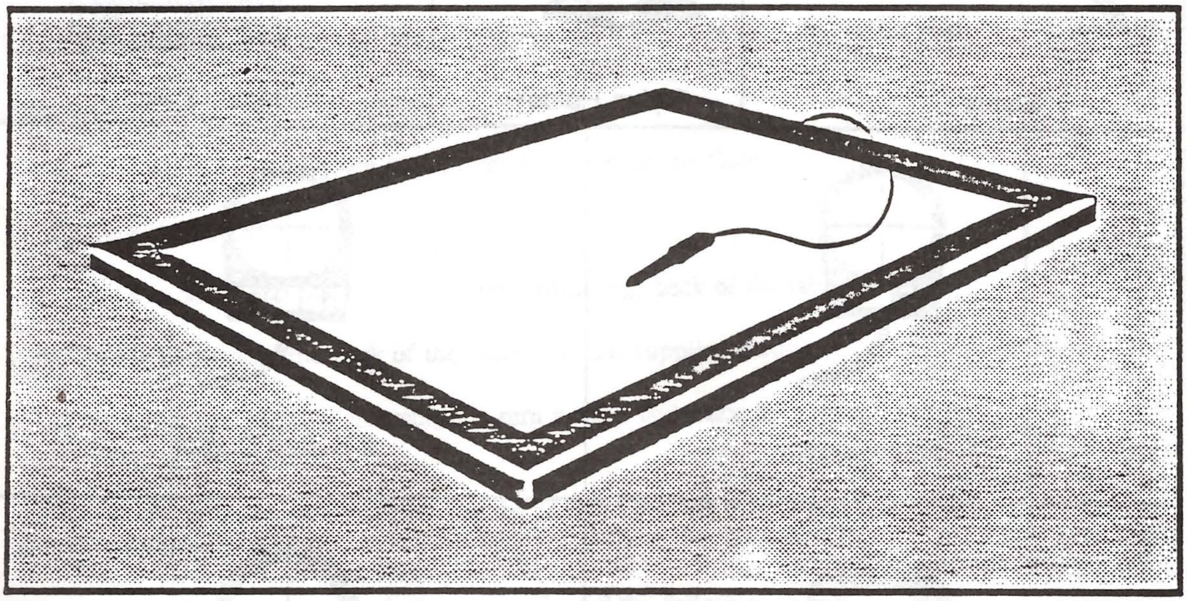


Figure 1.3a - Typical Large Digi-Pad Tablet With Stylus

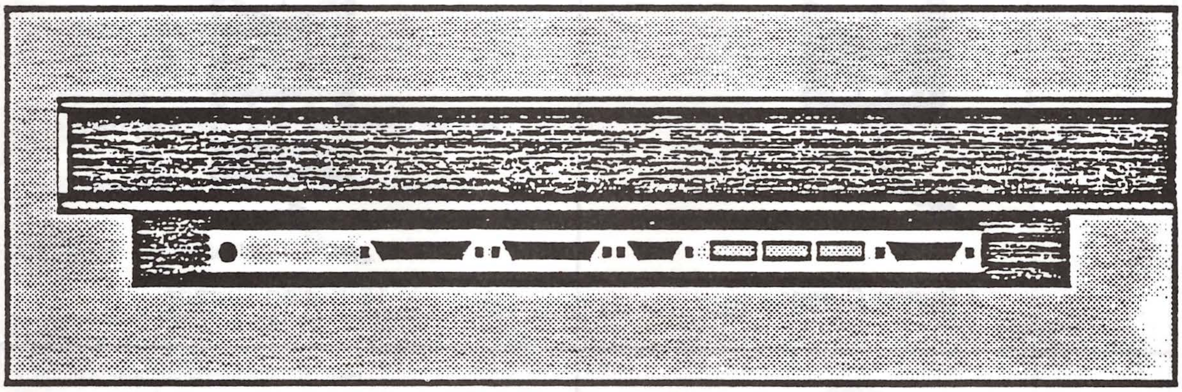


Figure 1.3b - Typical Large A Series Digi-Pad Tablet, Partial Rear View

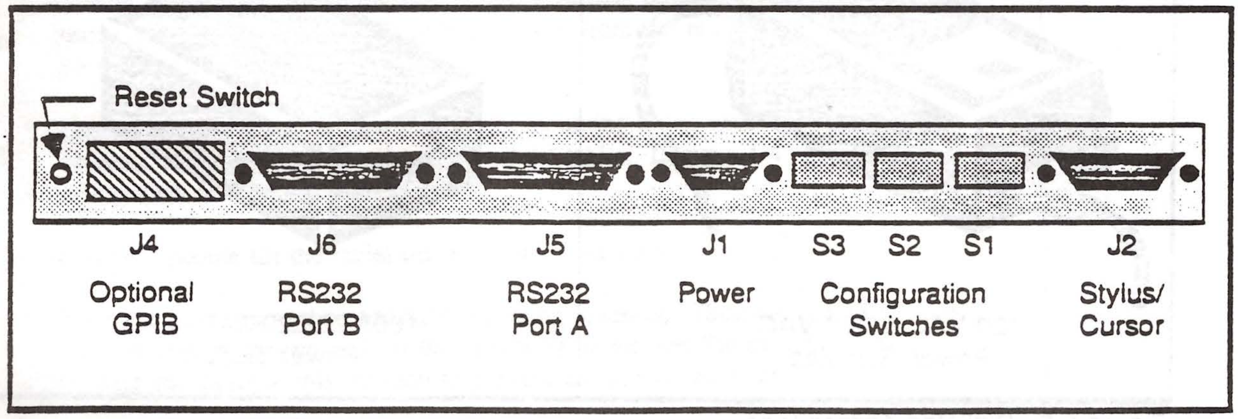
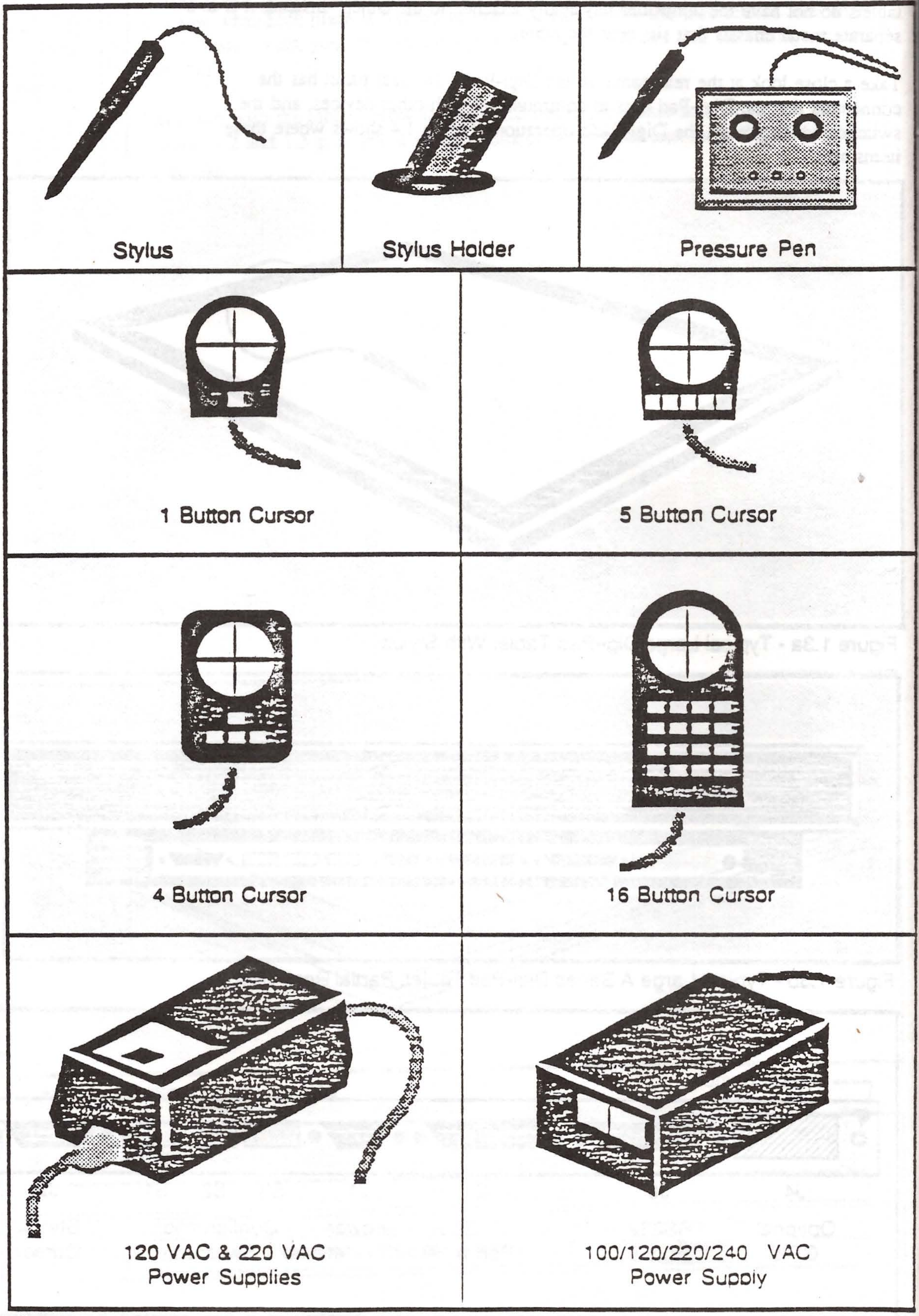


Figure 1.4 - Controller Rear Panel

Accessories

Finally, identify the accessories for the Digi-Pad. Depending on what you ordered, you will have some of these, but probably not all of them. Figure 1.5 shows accessories commonly used with Digi-Pads.



Stylus

Stylus Holder

Pressure Pen

1 Button Cursor

5 Button Cursor

4 Button Cursor

16 Button Cursor

120 VAC & 220 VAC
Power Supplies

100/120/220/240 VAC
Power Supply

Figure 1.5 - Digi-Pad Accessories

Mounting A Large Tablet On A Pedestal

If you didn't order a pedestal, you may skip this section and go directly to the next section, *Attaching The Accessories*.

Two kinds of pedestals are available to hold large Digi-Pad tablets. Power pedestals provide a powered lifting mechanism to raise and lower the tablet. A non-powered mechanism on the power pedestal allows you to change the tablet angle from horizontal to vertical or anywhere between. Manual pedestals have a mechanism you adjust by hand to change tablet height and tilt.

Manual Pedestal

The steps for setting up a manual pedestal depend on which size Digi-Pad tablet is to be mounted. Specific instructions will be found packed with the pedestal. The general instructions follow this sequence:

1. Place the tablet with top down on a protective cover on the floor.

2. Assemble the pedestal.

3. Invert the pedestal and place it on the (upward-facing) back of the tablet.

4. Secure the pedestal to the back of the tablet with the supplied hardware.

5. Lift the tablet and pedestal assembly up, turn it over, and place the pedestal feet on the floor.

Again, specific instructions accompanying the pedestal provide details you will need for your particular tablet.

Power Pedestal

To mount a tablet on a power pedestal, you will need the following things:

- 3/16" hex socket wrench
- 7/16" open end wrench
- Philips screwdriver
- Two people to hold the tablet for you

Read these instructions before you begin.

1. Unpack the pedestal.

2. Assemble the two legs to the pedestal base using the four bolts found in the base.

3. Stand the pedestal on its feet.

4. Position the pedestal mounting brackets to a vertical postion. CAUTION: The brackets are spring-loaded. Keep hands away from the brackets when operating the release mechanism.

5. Loosely install the 1/4-20 hex head tablet mounting bolts, with washers and lock washers, in the upper mounting holes on the tablet. Leave a 1/4" gap between the washers and the tablet.

6. Have two people lift the tablet up, and hold it vertically.

7. Move the tablet up to the pedestal's mounting brackets. Slide the hex head bolts into the slots in the top ends of the mounting plates (see Figure 1.6). Keep holding the tablet in this position to prevent damage to the bolts.

8. Insert the two socket head bolts, with washers and lock washers, through the holes near the bottom of the mounting brackets and screw them into the corresponding tablet holes.

9. Tighten all four tablet mounting bolts. Now your assistants can stop holding the tablet.

10. Locate the pedestal elevation switch box (it is on the end of a cable attached to the pedestal). Mount it to the tablet bottom near the front edge, using the two 6-32 x 7/16" screws with washers and lock washers.

11. Attach the pedestal elevation switch cable to the tablet back with adhesive pads and cable ties.

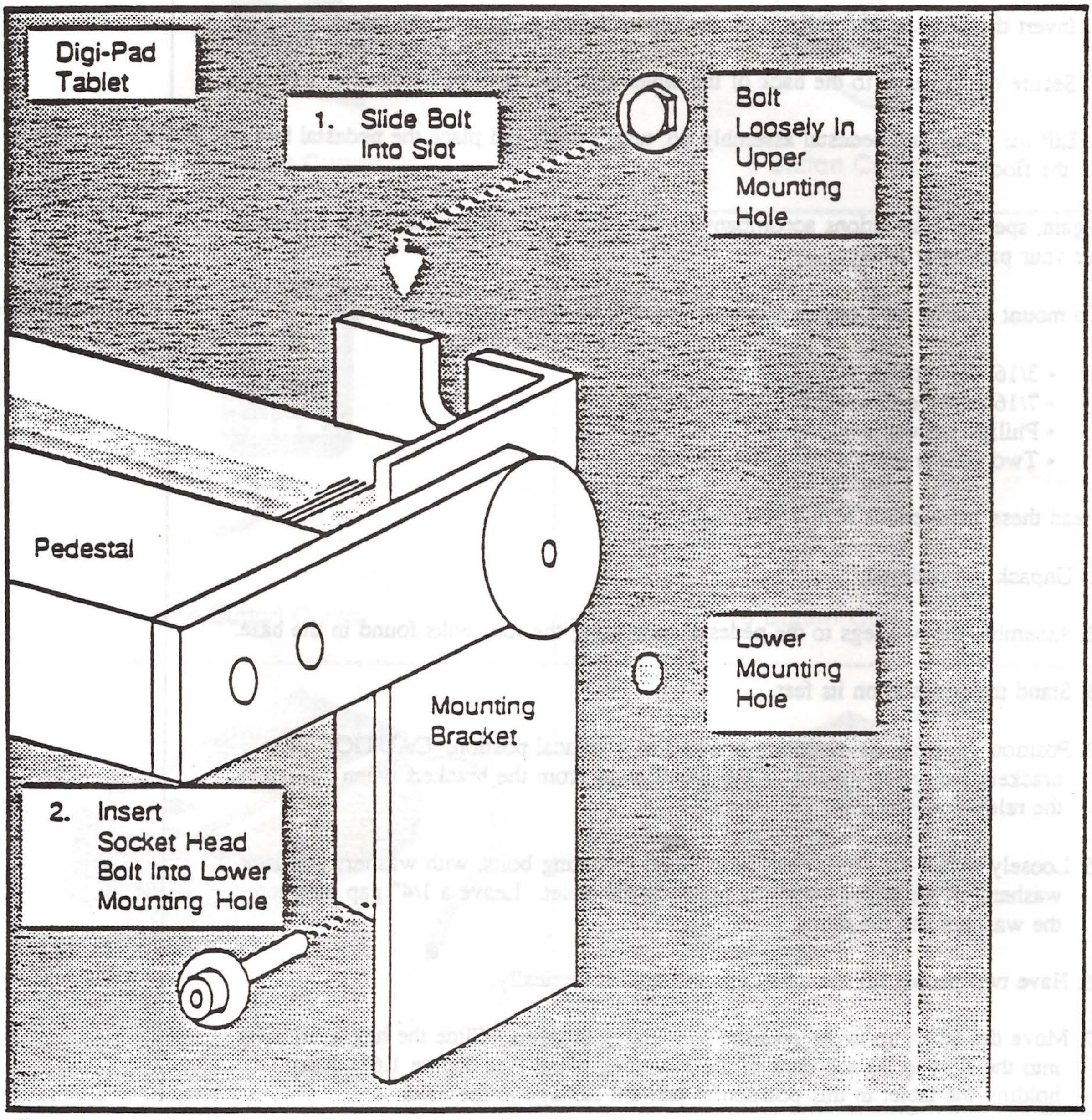

Digi-Pad Tablet
1. Slide Bolt Into Slot
Bolt Loosely In Upper Mounting Hole
Pedestal
Lower Mounting Hole
Mounting Bracket
2. Insert Socket Head Bolt Into Lower Mounting Hole

Figure 1.6 - Attaching Tablet To Pedestal (One Side Shown)

Attaching The Accessories

All Digi-Pad accessories connect to the controller's rear panel. You will need a straight-blade screwdriver to secure each connector.

First, attach the stylus or cursor to J2.

Next, attach the power supply to J1. (Note: If power is not provided by a GTCO-manufactured power supply, see *Using Other Sources Of Power* in Chapter 7.)

If you purchased a power supply for operation outside North America, you will need an AC line or mains cable. One end of the cable should have a connector to attach to the AC line or mains' in your country. The other end should have a standard EIA female connector to attach to the three-pin receptacle on the end of the Digi-Pad power supply. Your Digi-Pad dealer can assist you in finding the correct cable.

If you purchased the stylus holder, peel off the protective paper in the adhesive pad, and press the holder in place near an edge of the tablet.

Introduction To Digi-Pad Switches

The Digi-Pad controller has 24 switches that govern how it operates. These switches should be set so that when you apply power, the Digi-Pad will match your system and operating needs.

This section provides a general introduction to Digi-Pad switches. Details about what each switch controls, and how you should set it, are covered in Chapters 2 and 3.

You saw, in Figure 1.4, where the switches are located on the controller's rear panel. Figure 1.7 shows how the switches look up close. In Figure 1.7, the switches have reference numbers so you can identify each one.

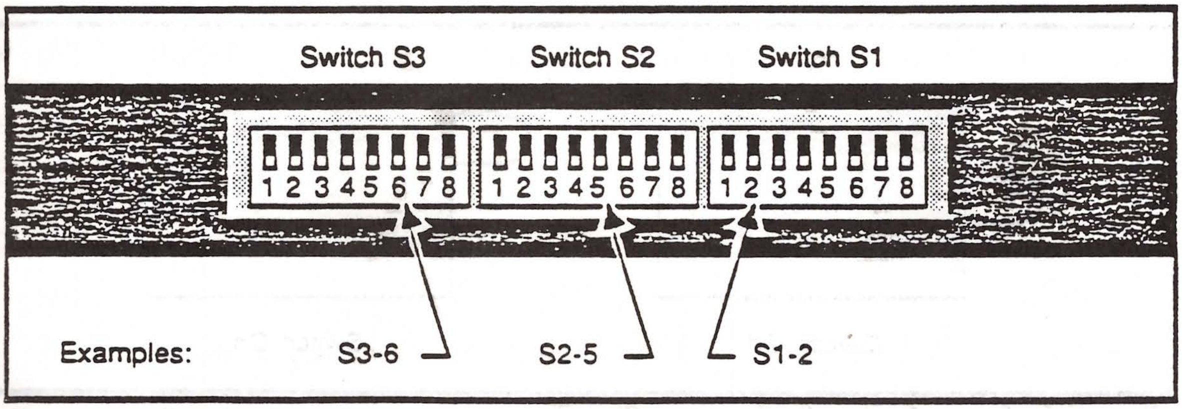


Figure 1.7 - Digi-Pad Switches

Each switch may be off or on. When a switch's lever is down, it is off and when the lever is up, it is on. These two positions are illustrated in Figure 1.8.

You will see in Chapters 2 and 3 that switch-selected functions require one or more switches to be set to certain positions. Take particular care in setting switches. If you set them improperly, the Digi-Pad won't do what you expect it to do. Once you have found the right combination of switch settings you probably won't have to change them again.

There are certain times when the Digi-Pad's internal microprocessor "reads" the switches to determine how you want it to operate. These times are:

- When power is applied to the Digi-Pad
- When you press the reset button on the Digi-Pad's rear panel
- When your system sends a Reset command to the Digi-Pad

Whenever one of these events happens, the Digi-Pad will revert to operating according to the switch settings you have made, no matter what commands it has received.

Changing Switch Settings

If you want to change operation using the switches, first change the switch settings. Then turn power off and on, or press the reset button or send a Reset command to the Digi-Pad. The Digi-Pad will now operate according to the new switch settings.

For your convenience in setting switches, the last page in this manual has a table summarizing the switch settings. Also, a condensed table appears on the bottom of small Digi-Pads and on the bottom of the controller housing on large Digi-Pads.

You can also change the way your Digi-Pad operates by sending commands to it. Many commands, but not all of them, duplicate switch selections. Commands take precedence over switch settings. Command selections remain in effect until changed by another command, or until one of the times listed above, when the microprocessor reads the switches. Note that operating changes made by commands are lost when power goes off.

Details of Digi-Pad commands are covered in Chapter 5.

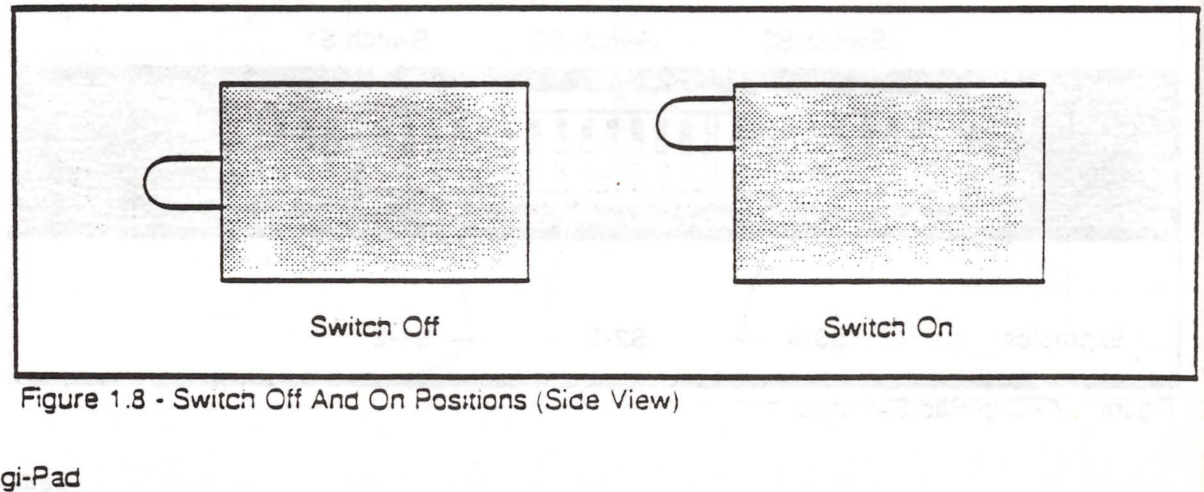


Figure 1.8 - Switch Off And On Positions (Side View)

Chapter 2

Making Communication Choices

As noted in Chapter 1, Digi-Pads are used in many different kinds of systems. It would be impossible for GTCO to provide details on how to connect a Digi-Pad to all the kinds of systems where it could be used. However, we can offer general information that will help you to connect the Digi-Pad to most systems.

This chapter helps you understand the different kinds of communications which the Digi-Pad can perform, and helps you choose one to use in your system. It also guides you in setting up the Digi-Pad to communicate properly with another device.

The computer or software in your system may have specific instructions you can follow to connect the Digi-Pad. If so, you may not need to read this chapter. Check the documentation that came with other parts of your system first.

Considering The Communication Alternates

The first step you will take in connecting the Digi-Pad to another device is to determine which method of communication best suits your needs. Your Digi-Pad has four ways to send data to other devices:

- RS232C
- Current Loop
- Serial TTL
- GPIB (IEEE-488)

The following paragraphs discuss the pros and cons of these methods.

RS232C

RS232C is a widely used serial interface between computers and peripherals. It is a (more or less) standard interface, and cables and connectors are available from a variety of sources. Most computers and peripherals either have an RS232C interface or can be equipped with one.

The Digi-Pad has two RS232C ports, J5 and J6. Each port can transmit XY coordinate data from the Digi-Pad. Additionally, each port can receive data from other devices and pass it through to the other port (more about this later). The Digi-Pad can also receive commands through its RS232C ports. Commands cause the Digi-Pad to change the way it operates (commands are described in Chapter 5).

RS232C communication is common and the Digi-Pad's RS232C ports are versatile. For those reasons, GTCO recommends using RS232C in your system.

Current Loop

Current Loop is a simpler serial interface than RS232C. While it used to be a common interface, it has been largely replaced by RS232C. Current Loop is not standardized, and requires that you prepare special cables to connect the Digi-Pad to your system.

The Digi-Pad has one Current Loop interface. It is available on two pins of J6. The Digi-Pad's Current Loop interface provides data output only, that is, you can send XY data from the Digi-Pad to other devices, but you cannot send data from other devices to the Digi-Pad. Before you can use Current Loop, you will have to know how it is implemented in the receiving device, a subject which is beyond the scope of this manual.

Serial TTL

Serial TTL is also a simple serial interface. It is much like Current Loop, but it uses different voltage and current levels. Your Digi-Pad has one TTL interface (one pin on J5 plus ground). It is a send-only interface and it cannot receive data or commands from other devices. You will have to make your own cable if you use this interface, and you will have to know how to receive TTL with your computer.

GPIB

GPIB is a high speed bit parallel, byte serial communication technique. GPIB interconnections and protocol are defined by the IEEE-488 standard. On the Digi-Pad, GPIB is an optional interface. If you ordered your Digi-Pad with a GPIB interface, you probably have other GPIB-equipped devices that you will attach to it. Chapter 6 contains GPIB operating details.

You must choose one of these interface methods for your Digi-Pad. Your selection will depend on the hardware and software in your system, and on your particular needs. Again, because it is widely used, RS232C is probably the best communication interface for most systems.

A Mini-Tutorial On RS232C Interfacing

If you have decided to use RS232C, you may need to know a little more about it. This section gives you the basics of the RS232C communication method so that you can use it in your graphic system. This section just describes RS232C, and doesn't give you details about how to set up the Digi-Pad for RS232C operation. You'll get specific instructions later in this chapter.

There are four areas to consider when using RS232C. They are:

- Character format and baud rate
- Cabling
- Flow control
- System interconnection

Let's discuss each of these in turn.

Character Format And Baud Rate

Character format and baud rate govern how bits are assembled to form characters and how fast those bits travel down the cable. Both the Digi-Pad and the computer must have identical formats and rates. These are the parameters you must set for both devices:

- Data bits: Data bits represent the actual data being sent from one device to another. Both devices must be set for the same number of data bits, usually 7 or 8. If they are not set the same, some or all of the data may be garbled.

- Parity: One bit may be allocated for parity (parity is a simple error-detecting scheme). Both devices must be set for the same parity—either odd parity or even parity—or they must be set for no parity. Most digitizing application software does not check for parity.

- Stop Bits: Each character has one or two stop bits, which tell the receiving device that this character is complete. The number of stop bits usually doesn't matter. Setting for two stop bits instead of one may overcome a mismatch in parity or data bits.

- Baud rate: Both devices must be set to send and receive data at the same rate. Commonly used rates are 300, 1200, 9600 and 19200 baud. The 9600 rate is popular for digitizing.

Cabling

Cabling is what carries the data from one device to the other. Most RS232C cables have male 25-pin subminiature D connectors on their ends to match female connectors on the equipment.

Data Terminal Equipment (DTE), such as printers, digitizers, and computers, usually (but not always) transmit data on Pin 2 and receive data on Pin 3. Data Communications Equipment (DCE), such as modems, generally transmit data on Pin 3 and receive data on Pin 2. Thus, connecting a terminal (DTE) to a modem (DCE) may be as simple as connecting them with a cable that is wired pin-to-pin (i.e., 1 to 1, 2 to 2, etc.). Figure 2.1 shows such a cable.

Connecting DTE to DTE, or DCE to DCE, may require a different strategy to get the data on the correct wires. Figure 2.2 shows a cable that can work in this situation. It is called a "null modem" cable, and it fools both devices into thinking they are talking with the right kind of receiver. This cable routes Pin 2 to Pin 3 and Pin 3 to Pin 2.

Your Digi-Pad has one DTE connector (J5, Port A) and one DCE connector (J6, Port B). This allows it to work with just about any RS232C device. If one port doesn't work, the other probably will.

J6 - Port B → DCE - {2 - Receive, 3 - Transmit}

J5 - Port A → DTE - {2 - Transmit, 3 - Receive}

Aleman: DTE

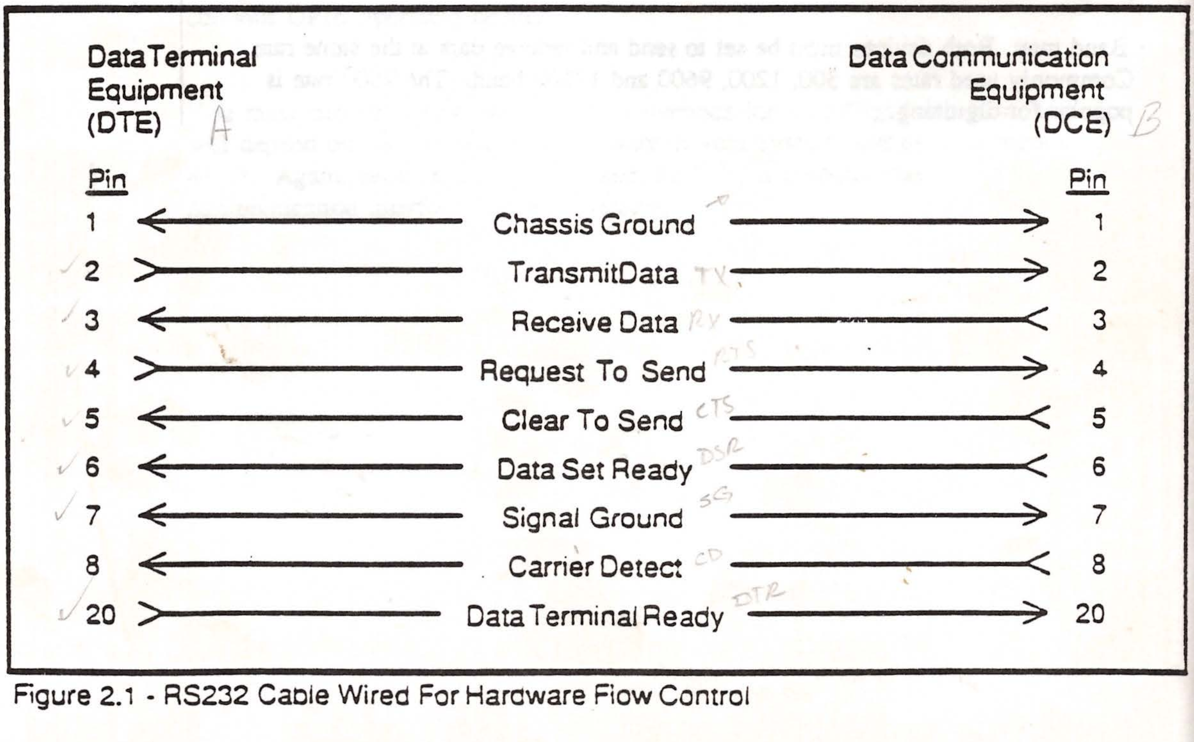


Figure 2.1 - RS232 Cable Wired For Hardware Flow Control

Flow Control

Flow control is the process of regulating the traffic or flow of data between two RS232C devices. Flow control prevents the transmission and subsequent loss of data if the receiver is not ready to accept it. Examples of devices that use flow control are: a printer to signal buffer full; a modem to indicate carrier detect; and a time-shared computer that services multiple users on a time-available basis. There are two kinds of flow control:

- Hardware flow control (also called modem lead flow control) uses several lines in the RS232C cable to send status signals from one device to another. The status signals have names such as Request To Send (RTS), Clear To Send (CTS), and Data Set Ready (DSR), among others. Each of these signals can be on or off, depending on the state of the device providing the signal. Hardware flow control requires a cable like that shown in Figure 2.1, in which wires pass these signals between devices.

- Character flow control is often used over communications links where only a 3-wire cable is used (Transmit Data, Receive Data, Ground), or over telephone lines. The sending device (such as the Digi-Pad) will immediately stop sending data when it receives an ASCII XOFF character. Transmission will resume when it receives an ASCII XON character. Character flow control will work with either of the cables shown in Figure 2.1 or Figure 2.2.

Flow control may not be needed when a terminal or digitizer is directly connected to a single-user computer. Most digitizing application software does not use flow control of either kind.

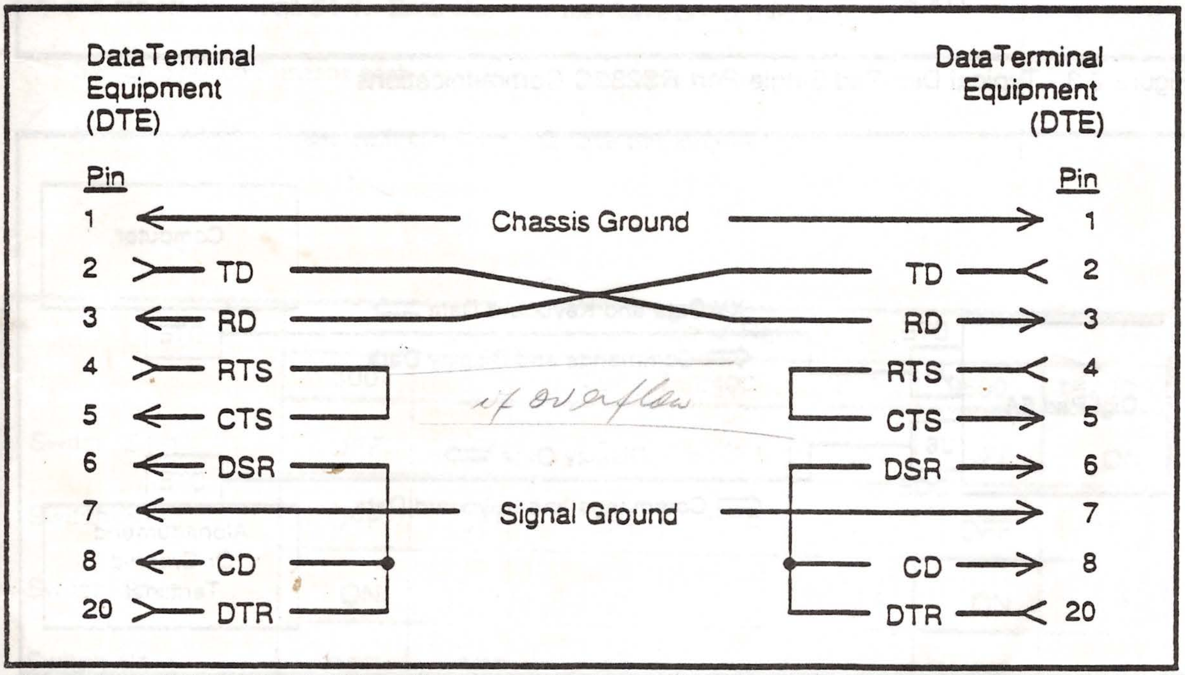


Figure 2.2 - RS232 Cable Wired To Ignore Hardware Flow Control

System Interconnection

System Interconnection is how you link the various pieces of equipment in your system so that they can communicate with each other. The figures on page 16 show you some ways a Digi-Pad can be connected to other devices.

First, the Digi-Pad may have just one port connected to another device, as shown in Figure 2.3.

Alternately, the Digi-Pad may connected between two other devices. In this setup, the Digi-Pad can pass along data between the two devices, in addition to sending out its own data to one or both other devices. Figure 2.4 shows how this can be done.

If you need more information about how the Digi-Pad's RS232C ports operate, Chapter 7 provides pin definitions and a functional diagram.

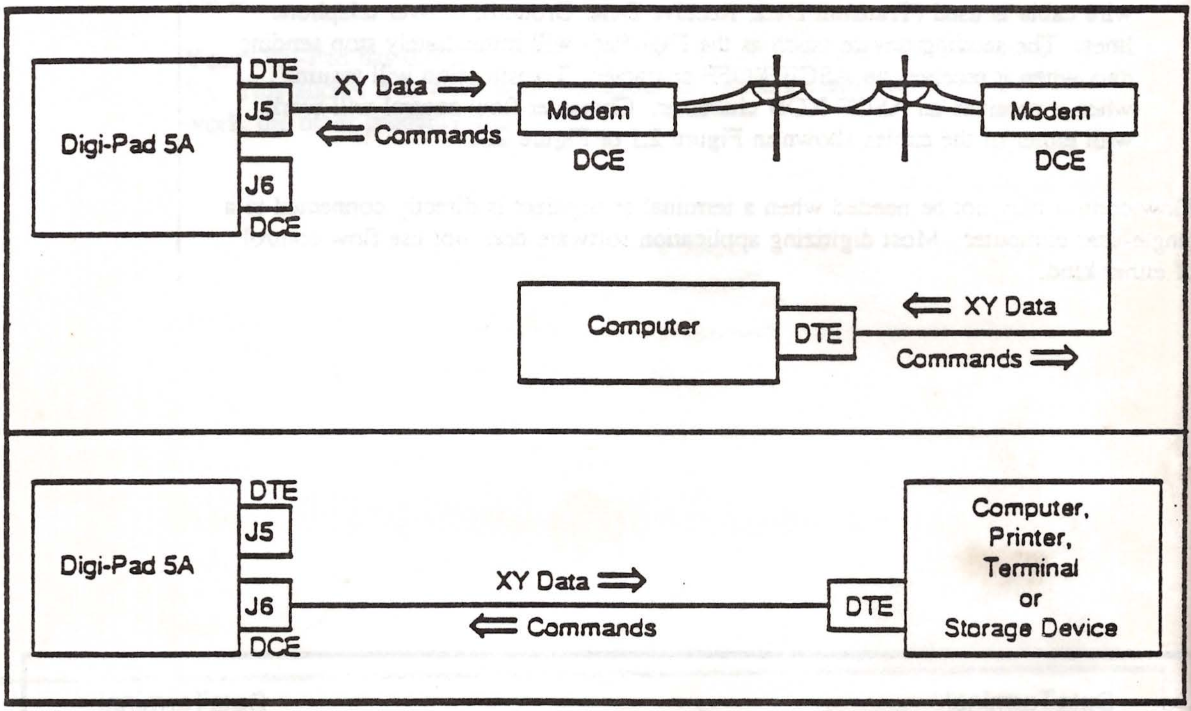


Figure 2.3 - Typical Digi-Pad Single Port RS232C Communications

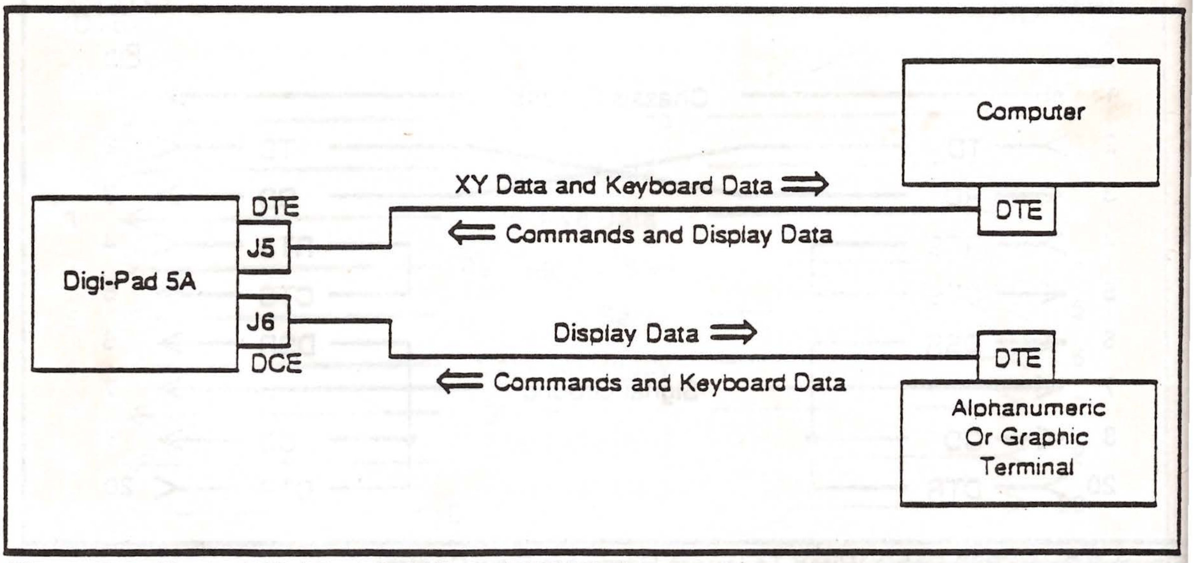

Computer
DTE
XY Data and Keyboard Data ⟹
⟸ Commands and Display Data
Digi-Pad 5A
DTE
J5
J6
DCE
Display Data ⟹
⟸ Commands and Keyboard Data
DTE
Alphanumeric
Or Graphic
Terminal

Figure 2.4 - Typical Digi-Pad Dual Port RS232C Communications

Setting Switches For Communication

The group of switches covered in this section selects the Digi-Pad's communication options. The functions covered here include character format, baud rate, flow control and which ports are active. The significance of these settings was discussed in the previous section. Recall that each of these parameters in the Digi-Pad must match the corresponding parameters in the computer and software you are using.

This section doesn't describe all the Digi-Pad's switches. Switches covering several other functions are covered in Chapter 3.

Be sure to read *Introduction To Digi-Pad Switches* in Chapter 1 before setting any switches.

Baud Rate 9600

Baud rate is set by a group of four switches: S1-1, S1-2, S1-3 and S1-4. First, 2400 determine the baud rate you need, then find it in Figure 2.5 below. For each baud rate, the table shows how to set the four switches. Switch settings not shown select 4800 baud. When all four of these switches are on, the Digi-Pad enters a special test mode. Do not select this test mode.

Parity enabled enabled

Parity is enabled or disabled by switch S1-5.

✓
- Switch S1-5 OFF means parity is disabled. There will be no parity bit in characters. default IBM 9000

- Switch S1-5 ON means parity is enabled. There will be one parity bit in characters.

Parity odd or even

Parity is set to odd or even by switch S1-6. This switch functions only when parity is enabled by Switch S1-5 being ON.

- Switch S1-6 OFF means the parity bit will signify odd parity. ✓

NA
- Switch S1-6 ON means the parity bit will signify even parity.

Stop Bits 1 stop bit

Data bits = 8

Stop bits are set by switch S1-7. Each character may have one or two stop bits.

- Switch S1-7 OFF means each character will have one stop bit.

✓
- Switch S1-~~8~~ 7 ON means each character will have two stop bits. default IBM 9000

default IBM 9000 ↓ ✓

	Baud Rate						
	300	600	1200	2400	4800	9600	19200
Switch S1-1	OFF	ON	ON	ON	ON	OFF	ON
Switch S1-2	OFF	OFF	ON	OFF	ON	OFF	OFF
Switch S1-3	ON	ON	ON	OFF	OFF	ON	ON
Switch S1-4	OFF	OFF	OFF	ON	ON	ON	ON

Figure 2.5 - Baud Rate Switch Settings

Data Bits

8 bits

Data bits are set by switch S1-8. Each character may have seven or eight data bits. If you will be using the high resolution binary format described in Chapter 3, switch S1-8 must be ON.

- Switch S1-8 OFF means each character has seven data bits.
- Switch S1-8 ON means each character has eight data bits.

Output Ports

S2-6 → OFF
S2-7 → ON

Output ports are selected by switches S2-6 and S2-7. You may have data transmitted on Port A only, Port B only, or on both Ports A and B simultaneously. A fourth option selects the GPIB port to be active, and requires that your Digi-Pad be equipped with the GPIB option (see Chapter 6 for details of GPIB operation). Pick the output ports that you want to be active from Figure 2.6, then set the two switches accordingly. If you are using only one port, it is alright for both ports to be active.

If you are using current loop to transmit data from the Digi-Pad, then Port B must be active. If you are using TTL to transmit data, then Port A must be active.

Hardware Flow Control

disabled? off

Hardware flow control is set by switch S3-8, and may be either disabled or enabled.

- ✓ Switch S3-8 OFF means that hardware flow control is disabled. The flow control input lines on Ports A and B are ignored. The flow control output lines on Ports A and B are held on.
- Switch S3-8 ON means that hardware flow control is enabled. The flow control input lines on Ports A and B are monitored. The states of these input lines are passed from one port to the output lines of the other port. The Digi-Pad obeys the states of the input lines.

Most applications work best with hardware flow control disabled.

Note that character flow control is always active. When the Digi-Pad receives an XOFF character, data output stops on the port where it was received. An XON character allows data output to resume. These functions are described more fully in Chapter 5.

IBM 9000: #SER01 – DCE
#SER02 – DTE ✓ ∴ use Port B (J6)

	Active Port			
	Serial Ports			
	A and B	A Only	B Only	GPIB
Switch S2-6	OFF	ON	OFF	ON
Switch S2-7	OFF	OFF	ON	ON

Figure 2.6 - Output Port Control Switch Settings

Chapter 3

Making Operating Choices

Besides the communication interfaces covered in Chapter 2, there are several other areas of Digi-Pad operation which can be configured to meet your needs. In particular, you may select the coordinate format, the digitizing mode and some other operating features. This chapter provides the information you need to understand what is available, and shows you how to set the Digi-Pad's switches so it will operate the way you want it to.

This chapter doesn't describe all the Digi-Pad's switches. Switches controlling communication functions are covered in Chapter 2.

Be sure to read *Introduction To Digi-Pad Switches* in Chapter 1 before setting any switches.

All of the functions described in this chapter may be altered by sending commands to the Digi-Pad through its RS232C or GPIB ports. Commands are described in Chapter 5.

The computer or software in your system may have specific instructions you can follow to select a format and other operating conditions. If so, you may not need to read this chapter. Check the documentation that came with the other parts of your system first.

Selecting The Coordinate Format

Coordinate format refers to the way the Digi-Pad encodes XY coordinate information before it sends the data out through a communication interface. The Digi-Pad and your application software must speak the same coordinate "language" for information to be properly transferred. You have three basic format choices to make:

- Binary versus ASCII encoded coordinates
- Low resolution versus high resolution coordinates
- English versus metric system coordinates

The sections that follow describe the formats available and show you how to set the Digi-Pad's switches so the format you want will be established whenever you apply power or reset the Digi-Pad. If you are developing your own software, these sections will also help you choose a format that suits your needs.

Binary Formats

Binary formats encode coordinate information compactly. Binary coordinate formats are shorter than ASCII formats, transmit faster and take up less space if stored on disk. On the other hand, binary formats cannot be directly displayed on a screen—they must be converted first into displayable characters.

Binary formats use the high order bit in each byte as a synchronization bit. The first byte in each format has its high order bit set to 1. The remaining bytes have their high order bits set to 0. The application program must examine the high order bit of each byte to determine when a format begins.

The Digi-Pad can produce two kinds of binary formats: low resolution and high resolution. They are quite different and will be described separately.

	Bit 7	6	5	4	3	2	1	0
	Parity	**Sync**	**Pushbutton Code**					**Always**
Byte 1		1	PB4	PB3	PB2	PB1	PB5	0
	Parity	**Sync**	**X Data, Low Order Bits**					
Byte 2		0	X5	X4	X3	X2	X1	X0
	Parity	**Sync**	**X Data, High Order Bits**					
Byte 3		0	X11	X10	X9	X8	X7	X6
	Parity	**Sync**	**Y Data, Low Order Bits**					
Byte 4		0	Y5	Y4	Y3	Y2	Y1	Y0
	Parity	**Sync**	**Y Data, High Order Bits**					
Byte 5		0	Y11	Y10	Y9	Y8	Y7	Y6

Where:

X11 and Y11	are most significant bits
X0 and Y0	are least significant bits (0.005" or 0.125 mm)
Pushbutton Codes	are as defined in Figures 3.5a or 3.5b

Figure 3.1 - Low Resolution Binary Format Bit Definitions

Low Resolution Binary Format

Low resolution binary format conforms to a de facto industry standard method of encoding small digitizer coordinate data. It is a fast, efficient and commonly used format. Low resolution binary formats are appropriate for applications needing low precision and using tablets smaller that 20" x 20". This format frequently is transmitted at 9600 baud.

The low resolution binary format is always five bytes long. Every bit in every byte has a pre-defined meaning. In this format, the least significant bit in the X and Y coordinates represents an increment of 0.005".

To select the low resolution binary format, you must set four switches on the Digi-Pad as follows:

- Set switch S3-7 ON to select general binary formats
- Set switch S2-5 OFF to select low resolution
- Set switch S1-8 OFF to select 7 data bits
- Set switch S1-5 ON to enable parity

Figure 3.1 shows the structure of the low resolution binary format at the bit level. Figure 3.2 gives an example of low resolution data and shows how the data fits into the format.

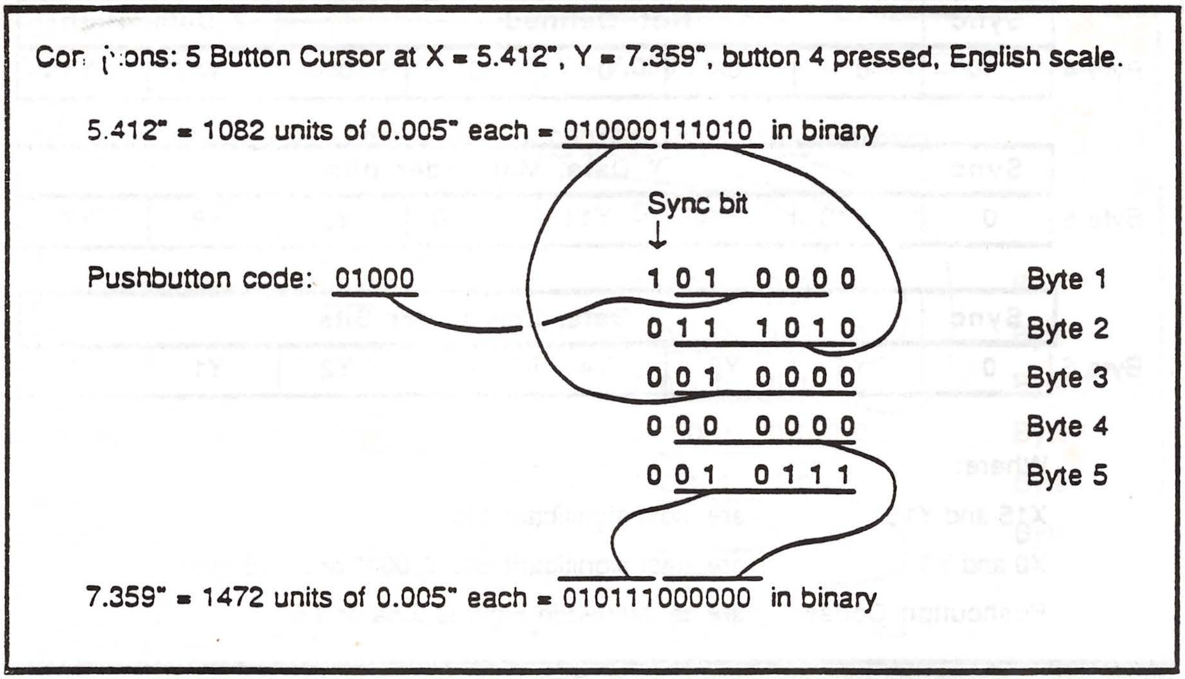

Conditions: 5 Button Cursor at X = 5.412", Y = 7.359", button 4 pressed, English scale.
5.412" = 1082 units of 0.005" each = 010000111010 in binary
Sync bit
Pushbutton code: 01000
1 0 1 0 0 0 0 Byte 1
0 1 1 1 0 1 0 Byte 2
0 0 1 0 0 0 0 Byte 3
0 0 0 0 0 0 0 Byte 4
0 0 1 0 1 1 1 Byte 5
7.359" = 1472 units of 0.005" each = 010111000000 in binary

Figure 3.2 - Low Resolution Binary Format Example

High Resolution Binary Format

High resolution binary format takes advantage of the Digi-Pad's ability to resolve cursor position to 0.001". This format defines each bit differently than the low resolution binary format, so these formats are not interchangable. The high resolution binary format is appropriate for applications needing maximum precision and for applications using tablets larger than 20" x 20".

To select high resolution binary format, you must set three switches on the Digi-Pad as follows:

- Set switch S3-7 ON to select general binary formats
- Set switch S2-5 ON to select high resolution
- Set switch S1-8 ON to select 8 data bits

Figure 3.3 shows the structure of the high resolution binary format at the bit level. Figure 3.4 gives an example of high resolution data and shows how it fits into the format.

	Bit 7	6	5	4	3	2	1	0
	Sync	Pushbutton Code					X Data, High	
Byte 1	1	PB5	PB4	PB3	PB2	PB1	X15	X14
	Sync	X Data, Mid Order Bits						
Byte 2	0	X13	X12	X11	X10	X9	X8	X7
	Sync	X Data, Low Order Bits						
Byte 3	0	X6	X5	X4	X3	X2	X1	X0
	Sync	Not Defined					Y Data, High	
Byte 4	0	0	0	0	0	0	Y15	Y14
	Sync	Y Data, Mid Order Bits						
Byte 5	0	Y13	Y12	Y11	Y10	Y9	Y8	Y7
	Sync	Y Data, Low Order Bits						
Byte 6	0	Y6	Y5	Y4	Y3	Y2	Y1	Y0

Where:

X15 and Y15	are most significant bits
X0 and Y0	are least significant bits (0.001" or 0.025 mm)
Pushbutton Codes	are as defined in Figures 3.5a or 3.5b

Figure 3.3 - High Resolution Binary Format Bit Definitions

Pushbutton Codes In Binary Formats

Pushbutton codes may be included in all Digi-Pad formats. You may define certain pushbuttons on your cursor to represent information that is relevant to your task. For example, the buttons on a 4 button cursor could represent four line widths or four colors in an original drawing. By including the pushbutton code in the format, the application program can handle this information appropriately.

Binary formats can include five bits which encode the pushbutton. The bits are active if switch S2-1 is ON. The bits transmitted in the format depend on the button pressed. Figures 3.5a and 3.5b show exactly which bits will be sent. Some examples of pushbutton codes are shown in Figures 3.6a and 3.6b. If switch S2-1 is OFF, then formats will contain zeroes for the pushbutton code bits.

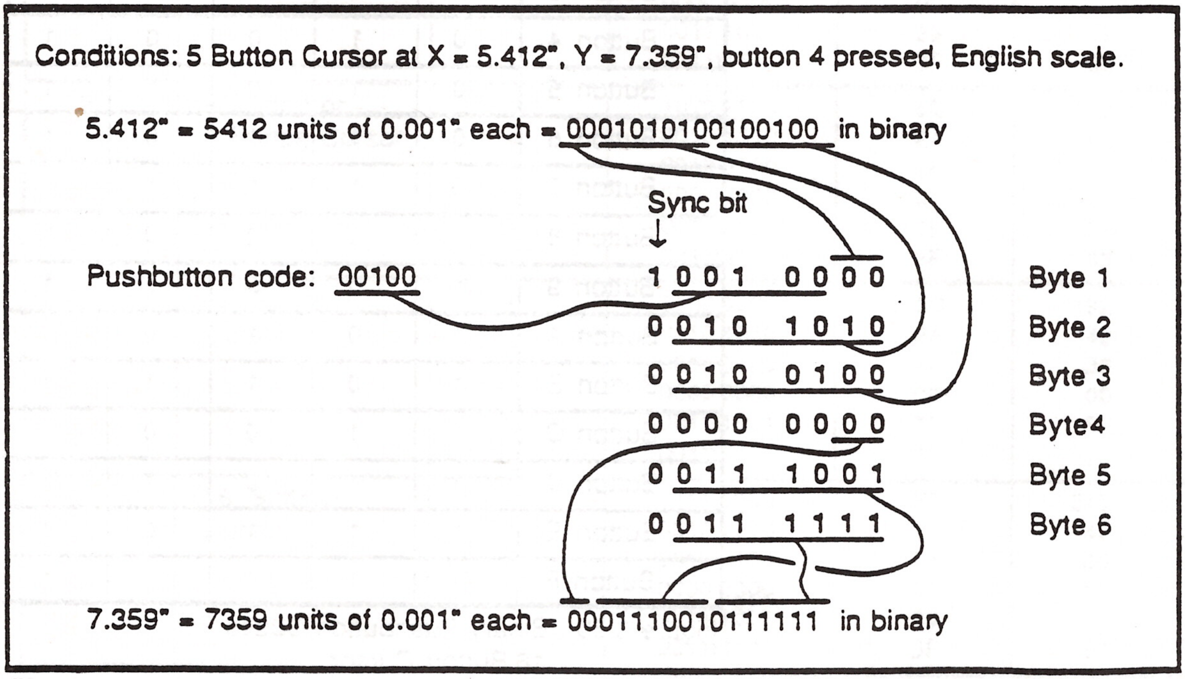

Conditions: 5 Button Cursor at X = 5.412", Y = 7.359", button 4 pressed, English scale.
5.412" = 5412 units of 0.001" each = 0001010100100100 in binary
Sync bit
Pushbutton code: 00100
1 0 0 1 0 0 0 0
0 0 1 0 1 0 1 0
0 0 1 0 0 1 0 0
0 0 0 0 0 0 0 0
0 0 1 1 1 0 0 1
0 0 1 1 1 1 1 1
Byte 1
Byte 2
Byte 3
Byte4
Byte 5
Byte 6
7.359" = 7359 units of 0.001" each = 0001110010111111 in binary

Figure 3.4 - High Resolution Binary Format Example

Type of Stylus Or Cursor Attached To Digi-Pad			Pushbutton Code in Binary Formats				
Stylus or 1 Button Cursor	4 Button Cursor	5 Button Cursor	PB4	PB3	PB2	PB1	PB5
Not pressed	None pressed	None pressed	0	0	0	0	0
Pressed	Red	Button 1	0	0	0	1	0
	Green	Button 2	0	0	1	0	0
	Blue	Button 3	0	1	0	0	0
	White	Button 4	1	0	0	0	0
		Button 5	0	0	0	0	1

Figure 3.5a - Binary Pushbutton Codes For Stylus,1 Button, 4 Button and 5 Button Cursors

16 Button Cursor	Pushbutton Code in Binary Formats				
	PB4	PB3	PB2	PB1	PB5
None pressed	0	0	0	0	0
Button 0	0	0	0	0	1
Button 1	0	0	0	1	1
Button 2	0	0	1	0	1
Button 3	0	0	1	1	1
Button 4	0	1	0	0	1
Button 5	0	1	0	1	1
Button 6	0	1	1	0	1
Button 7	0	1	1	1	1
Button 8	1	0	0	0	1
Button 9	1	0	0	1	1
Button A	1	0	1	0	1
Button B	1	0	1	1	1
Button C	1	1	0	0	1
Button D	1	1	0	1	1
Button E	1	1	1	0	1
Button F	1	1	1	1	1

Figure 3.5b - Binary Pushbutton Codes For
16 Button Cursor

Example Number	Cursor or Stylus Type	Button Pressed	Typical Format Transmitted		
			Binary	Hex	Decimal
1	Stylus or 1 Button Cursor	Barrel or Button	100 0100	44	68
			011 1010	3A	58
			001 0000	10	16
			000 0000	00	00
			001 0111	17	23
2	4 Button or 5 Button Cursor	3	100 1100	4C	76
			011 1010	3A	58
			001 0000	10	16
			000 0000	00	00
			001 0111	17	23
3	16 Button Cursor	0	100 0010	42	66
			011 1010	3A	58
			001 0000	10	16
			000 0000	00	00
			001 0111	17	23
4	16 Button Cursor	C	111 0010	72	114
			011 1010	3A	58
			001 0000	10	16
			000 0000	00	00
			001 0111	17	23

Figure 3.6a - How Pushbutton Codes Appear In Low Resolution Binary Formats

Example Number	Cursor or Stylus Type	Button Pressed	Typical Format Transmitted		
			Binary	Hex	Decimal
1	Stylus or 1 Button Cursor	Barrel or Button	1000 0100	84	132
			0010 1010	2A	42
			0010 0100	24	36
			0000 0000	00	00
			0011 1001	39	57
			0011 1111	3F	63
2	4 Button or 5 Button Cursor	3	1000 1100	8C	140
			0010 1010	2A	42
			0010 0100	24	36
			0000 0000	00	00
			0011 1001	39	57
			0011 1111	3F	63
3	16 Button Cursor	0	1100 0000	C0	192
			0010 1010	2A	42
			0010 0100	24	36
			0000 0000	00	00
			0011 1001	39	57
			0011 1111	3F	63
4	16 Button Cursor	C	1111 0000	F0	240
			0010 1010	2A	42
			0010 0100	24	36
			0000 0000	00	00
			0011 1001	39	57
			0011 1111	3F	63

Figure 3.6b - How Pushbutton Codes Appear In High Resolution Binary Formats

ASCII Formats

ASCII is a commonly used method for encoding text. ASCII coordinate formats can be directly displayed on most computer and terminal screens and can be easily handled by Basic programs. On the other hand, ASCII coordinate formats are longer than binary ones, so they take longer to transmit and they occupy more space if stored on disk.

- Set switch S3-7 OFF to select ASCII formats.

If you want to use ASCII coordinate formats, you still have more decisions to make. The simplest and shortest format consists of 8 characters. You may elect to add other characters, to create a format up to 14 characters long. Note that each of the optional characters may be selected by switch or by remote command.

Figure 3.7 shows the full range of characters that may be included in ASCII formats. Figure 3.8 shows some examples of ASCII formats.

Character Order	Character		Include Character
1 Optional	Pushbutton Code		If S2-1 ON yes
2	X1 (most significant digit)	X Coordinate Data	Always
3	X2		Always
4	X3		Always
5	X4		Always
6 Optional	X5 (least significant digit)		If S2-5 ON yes
7 Optional	Space		If S2-2 ON yes
8	Y1 (most significant digit)	Y Coordinate Data	Always
9	Y2		Always
10	Y3		Always
11	Y4		Always
12 Optional	Y5 (least significant digit)		If S2-5 ON yes
13 Optional	Carriage Return		If S2-3 ON yes
14 Optional	Line Feed		If S2-4 ON yes

Figure 3.7 - ASCII Format Definition, Showing Optional Characters

A format may include a carriage return, line feed or both. If it does, the application program can easily tell when each format is complete. ASCII formats do not contain decimal points, but the application program can insert them if they are needed.

If you are developing your own software, the ASCII format shown in Example 5 of Figure 3.8 is a good all around choice.

Example Number	Comment	What format looks like for X = 5.412", Y = 7.359"
1	Shortest ASCII format: low resolution, no space, no pushbutton code	05410736
2	Example 1 with space between coordinates	0541 0736 ↑
3	Example 2 with pushbutton code (button 3 pressed in this example)	30541 0736 ↑
4	Example 3 with high resolution data (5 digits for each axis)	305412 07359 ↑ ↑
5	High resolution with pushbutton code and no space	3541207359

Figure 3.8 - ASCII Format Examples (Carriage Return And Line Feed Not Shown)

Pushbutton Codes In ASCII Formats

When the pushbutton code is included in an ASCII format, it is the first character in the format. The character transmitted in the format depends on the button pressed. Figure 3.9 shows exactly which character will be sent. Some examples of pushbutton codes in ASCII formats are shown in Figure 3.10.

Note that codes for button 5 on a 5 button cursor and button F on a 16 button cursor will not appear in formats, if you are operating in point or line mode. See *Selecting The Digitizing Mode* in this chapter and *Cursor Lights And What They Mean* in Chapter 4 for details.

Type of Stylus Or Cursor Attached To Digi-Pad				ASCII Character In Format
Stylus or 1 Button Cursor	4 Button Cursor	5 Button Cursor	16 Button Cursor	
Not pressed	None pressed	None pressed	None pressed	0
			Button 0	0
Pressed	Red	Button 1	Button 1	1
	Green	Button 2	Button 2	2
	Blue	Button 3	Button 3	3
	White	Button 4	Button 4	4
		Button 5	Button 5	5
			Button 6	6
			Button 7	7
			Button 8	8
			Button 9	9
			Button A	:
			Button B	;
			Button C	<
			Button D	=
			Button E	>
			Button F	?

Figure 3.9 - ASCII Pushbutton Codes And Which Buttons Produce Them

Example Number	Digitizing Mode	Cursor or Stylus Type	Button Pressed	Typical Format, ↓ Pushbutton Code Here
1	Point	Stylus or 1 Button	Barrel or Button	105412 07359
2	Point	4 Button or 5 Button	1	105412 07359
3	Line	4 Button or 5 Button	3	305412 07359 305476 07401 305507 07482 ....
4	Point or Line	5 Button	5	No output - changes mode to Line or Point
5	Continuous	5 Button	5	505412 07359 505476 07401 505507 07482 ...
6	Point	16 Button	0	005412 07359
7	Line	16 Button	C	<05412 07359 <05476 07401 <05507 07482 ...
8	Point or Line	16 Button	F	No output - changes mode to Line or Point
9	Continuous	16 Button	F	?05412 07359 ?05476 07401 ?05507 07482 ...

Figure 3.10 - How Pushbutton Codes Appear In ASCII Formats

Measurement Scale

You can choose either English or metric scaling for the coordinates you digitize. The Digi-Pad applies the required conversion factor before constructing a coordinate format for output.

The numbers appearing in coordinate formats depend on three factors: format type (binary or ASCII), resolution (low or high) and measurement scale (English or metric). Figure 3.11 shows how these factors affect the data in coordinate formats.

Set measurement scale as follows:

- Set S3-6 OFF for English measurements, or
- Set S3-6 ON for metric measurements

english
ON

		English Measurement Scale	Metric Measurement Scale
ASCII Format	Low Res	Least significant digit = 0.010 inch 5.412", 7.359" gives 0541 0736	Least significant digit = 0.25 mm 5.412", 7.359" gives 0550 0748
	High Res	Least significant digit = 0.001 inch 5.412", 7.359" gives 05412 07359	Least significant digit = 0.025 mm 5.412", 7.359" gives 05498 07477
Binary Format	Low Resolution	Least significant bit = 0.005 inch 5.412", 7.359" gives In Binary — In Hex 100 0000 — 40 011 1010 X — 3A 001 0000 X — 10 000 0000 Y — 00 001 0111 Y — 17	Least significant bit = 0.125 mm 5.412", 7.359" gives In Binary — In Hex 100 0000 — 40 000 1011 X — 0B 001 0001 X — 11 001 0111 Y — 17 001 0111 Y — 17
	High Resolution	Least significant bit = 0.001 inch 5.412", 7.359" gives In Binary — In Hex 1000 0000 — 80 0010 1010 X — 2A 0010 0100 X — 24 0000 0000 Y — 00 0011 1001 Y — 39 0011 1111 Y — 3F	Least significant bit = 0.025 mm 5.412", 7.359" gives In Binary — In Hex 1000 0000 — 80 0010 1010 X — 2A 0111 1010 X — 7A 0000 0000 Y — 00 0011 1010 Y — 3A 0011 0101 Y — 35

Figure 3.11 - Data Resolution, With Format Examples for X=5.412", Y=7.359"

Selecting The Digitizing Mode

Digitizing mode refers to the method the Digi-Pad uses to determine when to generate a coordinate format. Six digitizing modes are available, but only one may be used at a time. The six choices are:

- Point mode
- Line mode (sometimes called switched stream mode)
- Continuous mode (sometimes called stream mode)
- Incremental mode
- Continuous incremental mode
- Remote request mode

The first four of these modes may be selected with switches. Continuous incremental and remote request may only be selected by remote commands (see Chapter 5). The following paragraphs describe the four switch-selectable modes and show you how to set the switches for the one you want.

Point Mode

Point mode: one coordinate format is sent when the stylus or a cursor button is pressed. Output occurs only when the stylus or cursor is in the active area.

Line Mode

Line mode: coordinate formats are sent as long as the stylus or a cursor button is pressed, with rate set by the digitizing rate switches S3-2 and S3-3 (see next section). Output occurs only when the stylus is in the active area.

If a 5 button cursor or 16 button cursor is attached to the Digi-Pad controller, you may change between point and line mode by pressing the designated cursor button. On 5 button cursors, use the button marked "PT/LN." On 16 button cursors, use the button marked "F."

- Set switch S3-4 OFF to select point/line mode

Continuous Mode

Continuous mode: coordinate formats are sent continuously, with rate set by the digitizing rate switches S3-2 and S3-3 (see next section). Output occurs only when the stylus or cursor is in the active area. Output occurs continuously, whether or not the stylus or a cursor button is pressed.

- Set switch S3-4 ON to select continuous mode

Incremental Mode

Incremental mode: one coordinate format is sent when the stylus or cursor is moved farther than a preset increment and the stylus or a cursor button is pressed. Output occurs only when the stylus or cursor is in the active area.

- Set switches S3-2 ON and S3-3 ON to select incremental mode

how closer ?

So that you will have a complete picture of digitizing modes, the remaining two are described below. These may be selected only by remote commands (see Chapter 5).

Continuous Incremental Mode

Continuous incremental mode: one coordinate format is sent when the stylus or cursor is moved farther than a preset increment or the stylus or a cursor button is pressed. Output occurs only when the stylus or cursor is in the active area.

Remote Request Mode

Remote request mode: one coordinate format is sent when a Read Current Coordinate command is received.

Figure 3.12 will help you compare and contrast digitizing modes.

Digitizing Mode	Action Caused By Entering Active Area	In Active Area: Action Caused By Pushbutton		Action Caused By Leaving Active Area	Other Action
		Off To On	On To Off		
Point	No Action	Send One Format	No Action	No Action	
Line	No Action	Send Many Formats	Stop Sending Formats	No Action	
Continuous	Send Many Formats	Causes No Change: Send Many Formats		Stop Sending Formats	
Incremental	No Action	Send One Format	No Action	No Action	Send One Format At Increment If Button Pressed
Continuous Incremental	Send One Format	Send One Format	Send One Format	No Action	Send One Format At Increment
Remote Request	No Action	No Action	No Action	No Action	Send One Format On Request

Figure 3.12 - Results of Active Area and Pushbutton Changes In Digitizing Modes

Making Other Operating Selections

There are three miscellaneous functions which you need to set on the Digi-Pad. These are the alarm, the cursor type and the digitizing rate. The following paragraphs help you decide how you want these functions to work and show you how to set the corresponding switches. Once the switches are set, the Digi-Pad will return to the functions selected by them when power is applied or when reset. The functions covered in this section may also be changed with commands (see Chapter 5).

Alarm

An alarm is provided so that the Digi-Pad can inform you of certain conditions. The conditions, and how the alarm sounds when they arise, are covered in *Tones And What They Mean* in Chapter 4. The alarm may be enabled or disabled by switch S2-8.

- Switch S2-8 OFF means you will hear only critical tones
- Switch S2-8 ON means you will hear all tones

Cursor

Cursor is selected by switch S3-5. You must set this switch to match the stylus or cursor connected to the Digi-Pad controller.

- Switch S3-5 OFF means you have a stylus, 1 button cursor, 4 button cursor or 5 button cursor attached
- Switch S3-5 ON means you have a 16 button cursor attached.

Digitizing Rate

Digitizing rate refers to how often the Digi-Pad generates an XY coordinate pair to send out in a format. The rate governs the frequency of format output for line mode and continuous mode. There are three rates which may be set by switches (other rates may be set by commands). Figure 3.12 shows how to set switches S3-2 and S3-3 to select a rate.

Note that rate is also dependent on the communication baud rate and format type you have selected. The rates shown in Figure 3.13 are therefore maximum rates.

	Rate, Coordinates/Second			Incremental Mode
	25	100	200	
Switch S3-2	OFF	ON	OFF	ON
Switch S3-3	OFF	OFF	ON	ON

Figure 3.13 - Digitizing Rate and Incremental Mode Switch Settings

Chapter 4

Using The Digi-Pad

This chapter gives you information on how to use the Digi-Pad to do digitizing jobs. Since the stylus or cursor is your main point of contact with the Digi-Pad, most of the chapter concentrates on these accessories. You will see how to hold both stylus and cursor, and learn what kinds of jobs are appropriate for each one. You will also learn about lights on the cursors and Digi-Pad alarm messages.

Applying Power

Before turning on the Digi-Pad, you should have read Chapters 1 through 3 and set up the Digi-Pad according to the instructions in those chapters, *or* you should have set up the Digi-Pad according to instructions supplied with other components of your graphic system. Setting up the Digi-Pad involves three general steps:

- Attaching the stylus (or cursor) and power supply to the controller (Chapter 1)
- Connecting the Digi-Pad to another device that will receive XY data, and setting the Digi-Pad switches controlling communications (Chapter 2 or other instructions)
- Setting the Digi-Pad switches controlling formats, operating mode and other functions (Chapter 3 or other instructions)

Only after you have performed these steps are you ready to apply power.

To apply power, first locate the on/off switch on the power supply. Then turn the switch on.

When power is applied to the Digi-Pad, it first performs diagnostic routines to determine whether its hardware and firmware are functioning properly. Then, it tells you the outcome by sounding its alarm in a distinctive pattern. Four identical high-pitched tones indicate the Digi-Pad is o.k. (For more information on tones, see *Digi-Pad Tones And What They Mean* later in this chapter.)

After sounding its alarm, the Digi-Pad configures itself according to the switch settings you have made. Then it is ready to begin digitizing.

A Brief Introduction To Digitizing

All digitizing is done within the tablet's active area. The active area is a rectangular region covering most of the tablet surface. When the stylus or cursor is inside the active area, the Digi-Pad can electronically sense it to generate XY coordinates. When the stylus or cursor is outside the active area, it is too far away for the Digi-Pad to sense its location, and the Digi-Pad cannot generate coordinates.

The active area extends at least one-half inch above the tablet surface (this height is different for different tablets). The active area's height is useful when you want to digitize or trace something that has thickness to it, like a book. Figure 4.1 will help you to visualize where the active area is.

Most Digi-Pad cursors have a red light that is on when the cursor is within the active area. By observing the red light, you can precisely find the edges of the active area on and above the tablet surface. If switch S2-8 is on, you will hear a tone whenever the stylus or cursor is outside the active area.

Some tasks involve placing a drawing, picture, menu or other flat material on the Digi-Pad's tablet. Such materials should be held in place with tape, so they will not move during the digitizing process.

As noted in the beginning of Chapter 1, the Digi-Pad generates and transmits coordinates almost instantaneously. Be aware that time delays between moving the stylus or cursor and seeing the result on a screen can occur. Such delays are caused by processing time in the computer. Especially long delays may be caused when the Digi-Pad's output rate exceeds the computer's processing rate.

When you are digitizing, the stylus or cursor is your main point of contact with the Digi-Pad. Whether you use a stylus or cursor depends primarily on the kind of task you have to do, and to a lesser extent on your personal preferences. In the next sections, you will see how to use these accessories and get suggestions about when to use each kind.

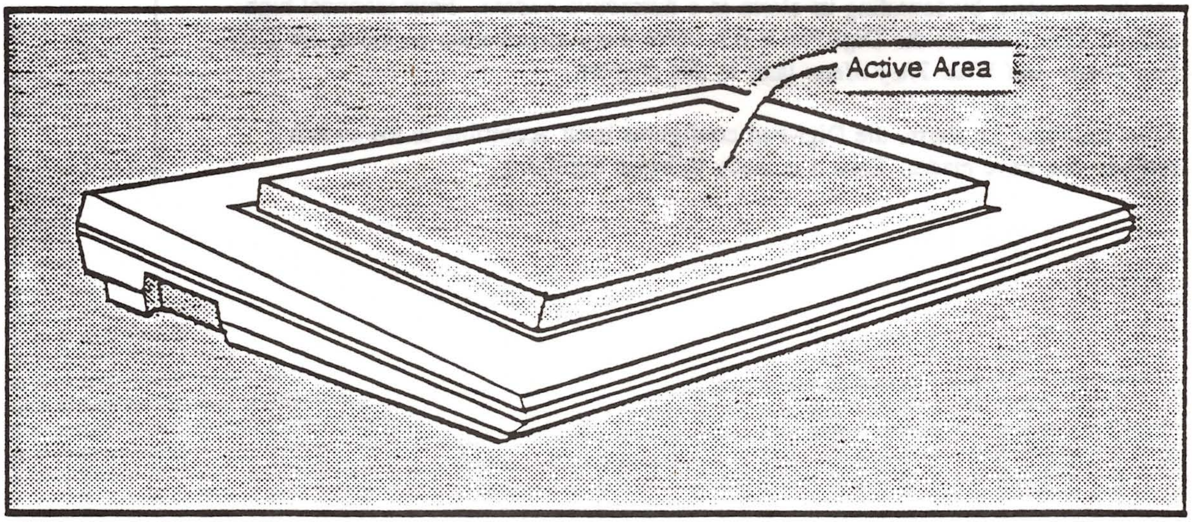


Figure 4.1 - Typical Tablet Active Area

Using A Stylus

A stylus is shaped like a pen or pencil, so it fits your hand naturally. You might use a stylus to generate original artistic graphics requiring careful finger and hand control. You might also use a stylus when most of your work is selecting commands from a menu or moving a pointer on a screen.

A stylus can be tilted so that it is not perfectly perpendicular to the tablet. When it is held like a pen or pencil, this angle aids in the natural and comfortable feel of the stylus (see Figure 4.2). The angle introduces a slight offset into the coordinate data. As long as the angle is about constant, the offset is about constant and the effect is minimal. Moving the stylus to a different angle will cause a different small offset.

A stylus is not the best choice for highly accurate work or tracing, since you cannot precisely control its angle and its tip can cover the point of interest. However, if you have the 4D Option (see Chapter 6), stylus tilt can work for you by providing an additional two dimensions of graphic information to your system.

The stylus has one switch, but it is inside the body where you can't see it. There is a movable tip that activates the switch when you press the stylus body downward. Here are two common ways to use the stylus switch:

To activate the switch with the stylus in one location (e.g., to select a menu item):

1. Put the stylus in the active area at the point of interest.
2. Press the stylus body toward the tablet (forcing the tip up into the body).
3. Relax and let the stylus body rise back to its starting position.

To activate the switch while moving the stylus (e.g., to move an object on a screen):

1. Put the stylus in the active area.
2. Press the stylus body toward the tablet and continue pressing while moving the stylus.
3. Finish by letting the stylus body rise back to its starting position.

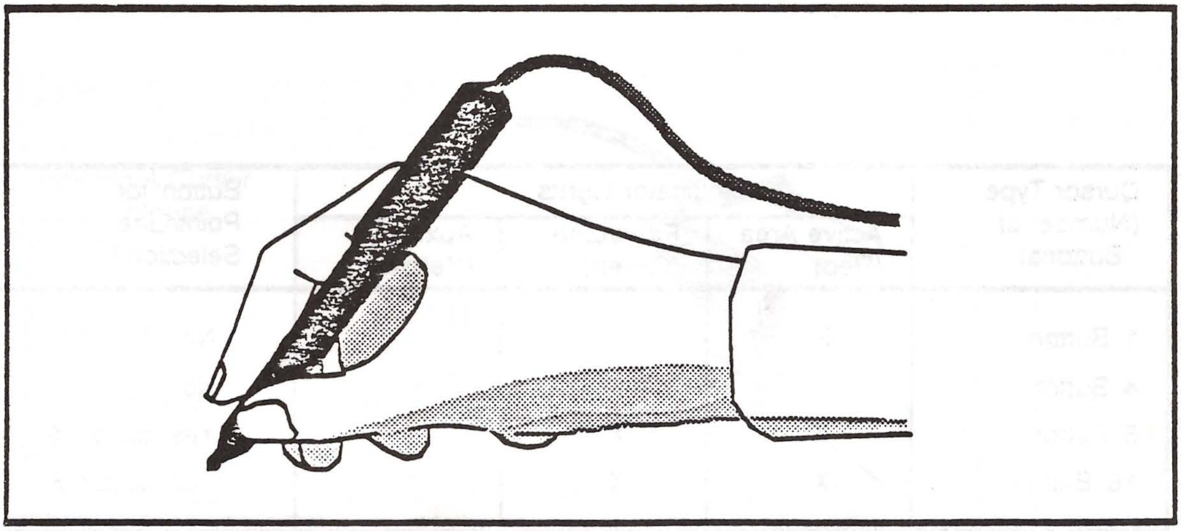


Figure 4.2 - How To Hold The Stylus

Using A Cursor

Digi-Pad cursors are different from the stylus in several ways:

- Cursors have switch buttons on top where you can see them.
- Cursors have viewing windows with crosshair reticles.
- Cursors lie flat on the tablet and do not tilt.

Four cursor types are available for the Digi-Pad. Besides the number of buttons, there are other features which make each kind unique. Figure 4.3 summarizes the differences.

It's not surprising that cursors can be used for different kinds of jobs than the stylus. Since cursors do not tilt (when they are flat on the tablet), they can be used for work requiring the highest precision. For example, you need high precision when you are digitizing an existing drawing or picture to create a duplicate inside your graphic system.

The cursor's viewing window is the key to placing it in the right spot on the drawing. The crosshairs intersecting in the center of the window give you an unchanging reference point for cursor placement.

For some activities, like making menu selections, the cursor can be used more casually because precise position is not needed. In other instances, the cursor can even be used like a mouse, with your hand covering up most of it. (A mouse is a simple graphic input device, shaped like a Digi-Pad cursor but without a viewing window, used for moving a pointer on a screen.)

What you do with the cursor dictates how you hold it. Figure 4.4 shows three ways to hold a cursor. The directions below describe the three methods and give you some idea about when each is appropriate.

We suggest you try all three methods of holding a cursor, just to get an idea of the options open to you, and to help you decide which methods are most appropriate for your work. Don't feel constrained to our suggestions, however. Exploring your own variations will lead to positions that are most comfortable for you.

Cursor Type (Number of Buttons)	Indicator Lights			Button for Point/Line Selection?
	Active Area (Red)	Point/Line (Green)	Auxiliary (Yellow)	
1 Button	X			No
4 Button				No
5 Button	X	X		Yes, button 5
16 Button	X	X	X	Yes, button F

Figure 4.3 - Cursor Feature Summary

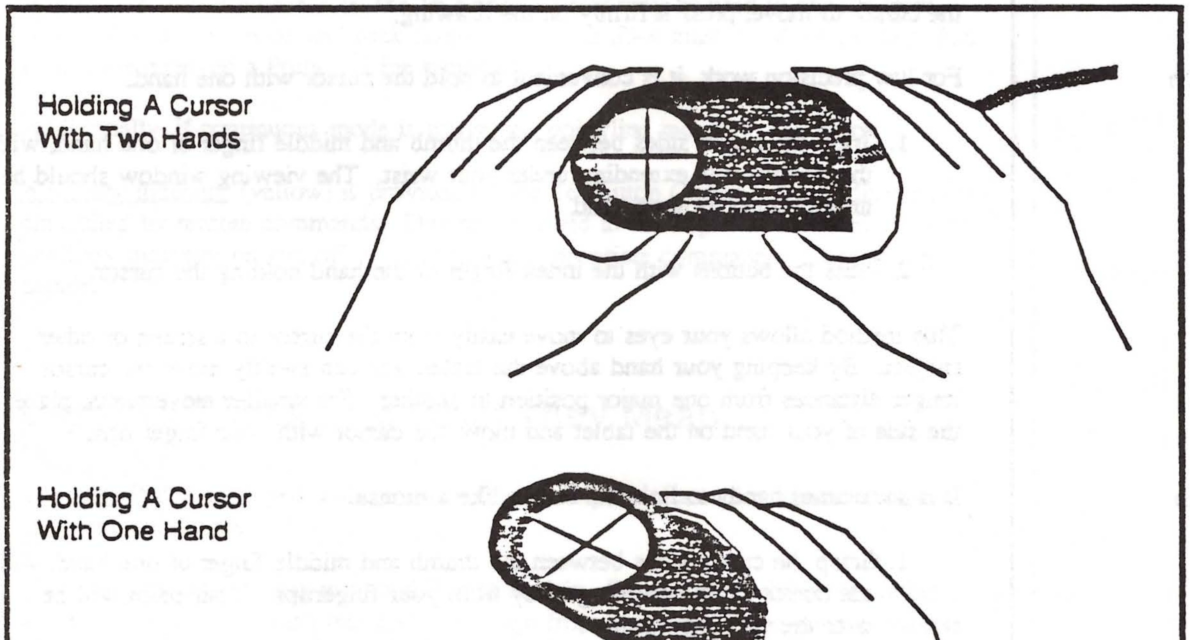


Figure 4.4 - How To Hold Cursors

Holding A Cursor With Two Hands

For high precision work, it is best to hold the cursor with two hands.

1. Place the cursor on your drawing on the tablet, with the cursor cable extending to the right or left.

2. Grasp the sides of the cursor with the fingers of both hands.

3. Place your head directly over the viewing window and look through it to position the crosshair intersection at the point of interest.

4. Use the index finger of the hand nearest the buttons to press the buttons.

By placing the sides of your hands solidly on the tablet and moving the cursor only with your finger tips, you can control its position precisely within small areas.

Precise work demands that your visual attention be on the drawing and on the cursor's crosshair intersection. If you must move your eyes to another subject and don't want the cursor to move, press it firmly on the drawing.

Holding A Cursor With One Hand

For low precision work, it is convenient to hold the cursor with one hand.

1. Grasp the cursor sides between the thumb and middle finger of one hand, with the cursor cable extending under your wrist. The viewing window should be unobstructed by your hand.

2. Press the buttons with the index finger of the hand holding the cursor.

This method allows your eyes to move easily from the cursor to a screen or other subject. By keeping your hand above the tablet, you can swiftly move the cursor longer distances from one major position to another. For smaller movements, place the side of your hand on the tablet and move the cursor with your finger tips.

Holding A Cursor Like A Mouse

It is sometimes handy to hold the cursor like a mouse.

1. Grasp the cursor sides between the thumb and middle finger of one hand, with the cursor cable extending away from your fingertips. Your palm will be over the viewing window.

2. Press the buttons with the index finger of the hand holding the cursor.

With this method, you can't see where the crosshairs are, so you can't position the cursor over a given point on the tablet. Using the cursor like a mouse is most useful when you are looking at a display screen or other subject, and not at anything on the tablet. In this case, it is the position of an object on the screen that is important, not the exact location of the cursor.

Cursor Buttons

Among other things, cursor buttons may be used to activate frequently used commands or menu selections, to indicate points of interest, and to select graphic objects. In general, the functions assigned to cursor buttons depend strictly on the software used in your system, and are unknown to the Digi-Pad. There are, however, two exceptions.

Button 5 on the 5 Button Cursor and button F on the 16 Button Cursor may be used to change from point mode to line mode and back (Digi-Pad switch S3-4 must be off or the Digi-Pad must have received a Point or Line command). When point or line modes are in effect, those buttons are dedicated to this mode selection function. Under the conditions noted, when either of these buttons is pressed once, the Digi-Pad changes to the alternate mode. When other digitizing modes are in effect, these buttons operate the same as all other cursor buttons.

Cursor Lights And What They Mean

You may have noticed in Figure 4.3 that the different cursor types have different indicator lights on them. This section describes what the indicators tell you about the Digi-Pad's operation.

Active area indicator (red) is on when the cursor is within the tablet's active area. Conversely, it is off when the cursor is outside the active area. Under most conditions, the Digi-Pad will not generate coordinate formats when the cursor is outside the active area, because cursor and tablet are too far apart for accurate sensing. The active area indicator is provided on 1, 5 and 16 Button Cursors.

Point/line indicator (green) tells you which of these two digitizing modes is in use. If point mode is active, the indicator is off. If line mode is active, the indicator is on. The point/line indicator is on 5 and 16 button cursors. Button 5 on the 5 Button Cursor and button F on the 16 Button Cursor may be used to change from point mode to line mode and back (Digi-Pad switch S3-4 must be off or the Digi-Pad must have received a Point or Line command).

Additionally, if continuous mode is active, the point/line indicator will be on.

Auxiliary indicator (yellow) is provided on the 16 Button Cursor. This indicator is controlled by remote commands. Devices attached to the Digi-Pad can turn the auxiliary indicator on and off by sending the appropriate commands. Chapter 5 gives details.

Digi-Pad Tones And What They Mean

The Digi-Pad is equipped with an alarm that gives you information about various operating conditions.

The alarm generates tones in four different pitches. Sequences of different pitches make it easy to distinguish one alarm message from another. We've given a number to each tone to help identify them. Tone 1 has the lowest pitch and Tone 4 has the highest pitch. Figure 4.5 lists the standard tone sequences and what each means.

Digi-Pad switch S2-8 controls the alarm. When switch S2-8 is off, the alarm will not sound some messages. Other messages are so important that they are sounded whether S2-8 is on or off. The latter group includes diagnostic messages, and tone sequences sent to the Digi-Pad by remote command.

Steven Kay

Tone Sequence	Repetitions	What It Means	S2-8
4 4 4 4	1 time	Heard at power-on or reset. Digi-Pad has successfully passed its self-test.	Heard whether Switch S2-8 is ON or OFF. Heard even after a Disable Alarm command has been received.
4 3 2 1	4 times	Heard at power-on or reset. Tablet check-sum is incorrect (high accuracy version only).	
4 1 4 1	Continuously	Heard at power-on or reset. RAM test failed.	
4 4 4 4 4	Continuously	Heard at power-on or reset. PROM test failed.	
1	1 time	Heard at power-on or reset. PROM checksum missing.	
2 1 3 4	4 times	Heard at power-on or reset. No tablet detected.	
2 1 2 1	1 time	Heard at power-on or reset. Tablet size unknown.	
4 4 4 4 4	2 times	Heard at power-on or reset. Tablet missing at least one line.	
Other sequences	Heard well after power-on or reset. Tone command sequences sent to the Digi-Pad by another device.		
4 ---------	Continuously	Heard when digitizing. Stylus or cursor is outside tablet's active area. Tone sounds until stylus or cursor goes back in.	Heard only when Switch S2-8 is ON or after an Enable Alarm command has been received.
3	Once each time a button is pressed.	Heard while digitizing. One point has been digitized in Point Mode.	
2 ... 2 ...	Once per second	Heard periodically while digitizing. Points are being digitized in Line Mode.	
4 1 4 1	1 time	Entering Command Mode.	
1 1	1 time	Command completed.	
4 4	1 time	Command not understood.	
4	1 time	Leaving Command Mode.	

Figure 4.5 - Tones And What They Mean

Chapter 5

Using Remote Commands

The Digi-Pad can receive commands from other devices. Commands cause the Digi-Pad to change the way it operates, to use certain coordinate formats and to do other things as directed by you or by an application program.

Commands offer another way to control Digi-Pad operation besides the switches discussed in Chapters 2 and 3. Certain Digi-Pad functions may be carried out only through commands.

This chapter begins with a general introduction to commands. Several tables summarize the commands and give you an overview of the commands available. Then, each command is described in detail, so that you will know exactly what it does.

If you are developing your own application software, be cautious about using commands in your program. A momentary glitch in power to the Digi-Pad will cause it to discard any command changes it has received and set itself according to its switches. This could leave your program confused about what the Digi-Pad is doing. A full system reset would then be needed to get Digi-Pad and computer coordinated again. A prudent programmer will limit command control of a Digi-Pad.

Mastering The Basics Of Command Mode

The Digi-Pad can receive commands through either of its RS232C ports, or through the optional GPIB port.

Entering Command Mode begins by sending an ASCII Control A (hex 01) character to the Digi-Pad. When the Digi-Pad receives the Control A, three things happen.

First, digitizing stops and new coordinate formats are not generated. If Command Mode is invoked during transmission of a coordinate format, that format transmission will be completed.

Second, the port receiving the Control A is designated the Command Port. The Command Port may be RS232C Port A, RS232C Port B or the GPIB port. While Command Mode is in effect, no other port may become the Command Port until the currently assigned port has relinquished control and the Digi-Pad returns to digitizing.

Third, the Digi-Pad sends a > (hex 3E) through the Command Port as a prompt to the commanding device. The Digi-Pad is now ready to accept commands.

A command consists of two upper case ASCII letters or numbers followed by a delimiter. The delimiter lets the Digi-Pad know the command is complete. There are two kinds of delimiters, as shown in Figure 5.1

If the command entered is not a valid command, regardless of the delimiter, it will be ignored and the Digi-Pad will send a question mark. If the delimiter following an invalid command was an Escape, the Digi-Pad stays in the Command Mode.

A command may be aborted before entering a delimiter by sending a Control X (hex 1B). The Digi-Pad then ignores the preceding one or two characters and responds with a new prompt.

Leaving Command Mode is done by sending an Escape (hex1B). The escape may follow a command code, or it can be sent in response to the Digi-Pad's prompt. The Digi-Pad returns to digitizing, now operating according to the commands sent to it.

Command Summary

The Digi-Pad responds to more than 35 commands. Before describing them in detail, it will be helpful to simply list them, so you can see the breadth of what is available. Commands may be split into four groups:

- Functional control commands
- Format selection commands
- Alarm and status LED commands
- Diagnostic commands

Figures 5.2 through 5.5 list these command groups. Each line shows a command name and its corresponding command code.

Delimiter	Meaning
Carriage Return	End of current command input, but more commands will follow. If the command just sent is a valid command, it will be carried out. The Digi-Pad then sends another > and awaits the next command input.
Escape	End of current command input, and no more commands will follow. If the command just sent is a valid command, it will be carried out. Then the Digi-Pad will return to digitizing.

Figure 5.1 - Command Delimiters And What They Mean

Code	Functional Control Commands
RS	Reset
PT	Select Point Mode (overrides cursor)
LN	Select Line Mode (overrides cursor)
CN	Select Continuous Mode
IC	Select Incremental Mode
CL	Select Continuous Incremental Mode
RM	Select Remote Mode
OP	Send Coordinates 0,0 When Stylus/Cursor Is Out Of Active Area
IP	No Output When Stylus/Cursor Is Out Of Active Area
IV	Set Increment Value
Rx	Set Digitizing Rate (x = rate code)
MC	Change Mode Character
5B	Stylus Or 1 Button Or 4 Button Or 5 Button Being Used
6B	16 Button Cursor Being Used
EN	Select English Measurement Scale
MT	Select Metric Measurement Scale
PA	Send Coordinate Formats From Port A Only
PB	Send Coordinate Formats From Port B Only
AB	Send Coordinate Formats From Port A and Port B
02 hex	Read Current Coordinate (only valid after Remote Mode has been selected and Digi-Pad is in Digitizing Mode)

Figure 5.2 - Functional Control Command Summary

Code	ASCII Format Selection Commands	Binary Format Selection Commands
AS	ASCII Format Output	
BI		Binary Format Output
LR	Low Resolution	Low Resolution
HR	High Resolution	High Resolution
PI	Pushbutton Include	Pushbutton Include
PE	Pushbutton Exclude	Pushbutton Exclude
SI	Space Include	
SE	Space Exclude	
CI	Carriage Return Include	
CE	Carriage Return Exclude	
LI	Line Feed Include	
LE	Line Feed Exclude	

Figure 5.3 - Format Selection Command Summary

Command Descriptions

Functional Control Commands

Reset Code: RS

Reset is equivalent to applying power to the Digi-Pad. The controller performs its diagnostic and initialization routines, sets various default conditions, and sets itself up according to switches S1-1 through S3-8.

If a coordinate format is being sent when the Reset command is received, reset operations will be delayed until after the format is completely sent. If Echo Mode is enabled, the Reset command is ignored.

Select Point Mode Code: PT

In point mode, one coordinate format is sent when the stylus or a cursor button is pressed. Each format contains the current coordinate. No format is sent when the stylus or cursor button is released.

Select Line Mode Code: LN

In line mode, a series of coordinate formats is sent while the stylus or a cursor button is pressed. The formats are sent at the rate set by switches S3-2 and S3-3 or the Set Data Rate command. Each data format contains the current coordinate. No data is sent after the stylus or cursor button is released.

Code	Alarm and Status LED Commands
AE	Enable Alarm
AD	Disable Alarm
T1	Sound Tone 1
T2	Sound Tone 2
T3	Sound Tone 3
T4	Sound Tone 4
T0	Tone Pause
ON	Turn Status LED On
OF	Turn Status LED Off

Figure 5.4 - Alarm And Status LED Command Summary

Code	Diagnostic Commands
VR	Transmit Version Number
SN	Transmit Serial Number
SZ	Display Tablet Active Area Size
RD	Read Tablet Diodes
EM	Enable Echo Mode
0F hex	Disable Echo Mode

Figure 5.5 - Diagnostic Command Summary

Select Continuous Mode Code: CN

In continuous mode, coordinate formats are sent continuously, regardless of whether the stylus or a cursor button is pressed. The formats are sent at the rate set by switches S3-2 and S3-3 or the Set Data Rate command. Each format contains the current coordinate.

If button codes are enabled in formats, they will be included only when a button is pressed. When no button is pressed, then formats will contain zeroes for the button codes.

Select Incremental Mode Code: IC

In incremental mode, the stylus or a cursor button must be pressed to begin format output. Pressing the stylus or a cursor button causes the Digi-Pad to transmit one format with the current coordinates. These coordinates become the reference point for increment calculations.

As long as the stylus or cursor button remains pressed, output will occur whenever the stylus or cursor has moved a non-cumulative distance equal to the increment value.

Select Continuous Incremental Mode Code: CL

In continuous incremental mode, formats are sent only whenever the stylus or cursor has moved from the previously transmitted coordinate by a non-cumulative distance equal to the current increment value, regardless of whether the stylus or a cursor button is pressed. If the stylus or cursor has not moved sufficiently from the last transmitted coordinate to trigger another transmission, and the stylus or a cursor button is pressed or released, a format with the current coordinate is transmitted.

Select Remote Mode Code: RM

In remote mode, the Digi-Pad transmits one coordinate format when it receives a Read Current Coordinate command.

Send Coordinates 0,0 When Stylus/Cursor Is Out Of Active Area Code: OP

No Output When Stylus/Cursor Is Out Of Active Area Code: IP

Certain situations require that the Digi-Pad be able to send a format when the stylus or cursor is out of the active area. Command OP permits coordinate formats to be sent under this condition. Since valid coordinates are not available when the stylus or cursor is out of the active area, coordinates 0,0 are substituted in the format.

When this command has been executed, most digitizing modes operate as described in this section, whether the stylus or cursor is in the active area or not. The two exceptions are incremental and continuous incremental modes. Operation of these modes requires valid coordinates. In either of these modes, when the stylus or cursor is out of the active area, coordinate formats are transmitted only when the stylus or a cursor button is pressed.

Command IP returns the Digi-Pad to the default condition, in which coordinate formats are not sent when the stylus or cursor is out of the active area.

Set Increment Value Code: IV

In the incremental and continuous incremental modes, the Digi-Pad outputs a format when the stylus or cursor is moved beyond a certain incremental distance in either X or Y direction. The Set Increment Value command allows the user to select the distance which the stylus or cursor must move to initiate format output.

After receiving the command, the Digi-Pad expects an increment code followed by a carriage return. The increment code consists of three ASCII digits which correspond to the number of mils (one mil is 0.001") in the increment. In the range of values from 015 through 250, codes should end in 0 or 5; if they do not, the increment will be set to the nearest valid value. Codes greater than 250 will set the increment to 0.250".

The default increment value is 0.010". The Figure 5.6 shows how increment values are assigned from the codes sent to the Digi-Pad.

Examples: code 007 sets increment value to 7 mils; code 008 sets increment value to 8 mils; code 057 sets increment value to 55 mils; code 058 sets increment value to 60 mils; code 357 sets increment value to 250 mils. Reset command, reset switch and power on all set increment value to 10 mils.

Set Digitizing Rate Code: Rx

Coordinates may be sent from the Digi-Pad at rates from 5 to 200 formats per second. The second character in this command sets the rate, as shown in Figure 5.7.

Actual rates depend on the communication baud rate and format type you have selected. The rates shown here are therefore maximum rates.

Change Mode Character Code: MC

Some applications may have a predefined meaning for the SOH character used to invoke Command Mode. If so, invoking Command Mode may cause your system to do something else. You may set the Digi-Pad so that a character other than SOH can be used to begin Command Mode. Here is how to make the substitution:

1. Enter the Command Mode.
2. Send the Change Mode Character command, MC, followed by a carriage return. The Digi-Pad responds with the prompt message "ENTER NEW COMMAND MODE CHARACTER".

Codes	Increment Value	Increment Resolution
001 through 010	0.001 inch through 0.010 inch	0.001 inch
015 through 250	0.015 inch through 0.250 inch	0.005 inch

Figure 5.6 - Increment Size Codes

Digitizing Rate Command	Digitizing Rate, Formats/Second
R1	25
R2	100
R3	200
R4	5
R5	10
R6	50

Figure 5.7 - Rate Commands

3. Enter the desired mode change character. The new mode character may be any character except ESC (control [, hex 1B), carriage return (control M, hex 0D), CAN (control X, hex 18), VT (control K, hex 0B), XON (control Q, hex 11), or XOFF (control S, hex 13).

Now, when you want to enter the Command Mode, send the new character. All other operations described in this chapter remain unchanged.

Stylus Or 1 Button Or 4 Button Or 5 Button Cursor Being Used Code: 5B

16 Button Cursor Being Used Code: 6B

These commands allow the application program to designate that the stylus or a particular cursor is attached to the Digi-Pad. Improper operation will result if this command designates the wrong accessory.

Select English Measurement Scale Code: IN

Select Metric Measurement Scale Code: MT

Invoking these commands causes the Digi-Pad to scale coordinates in the desired measurement system. The Digi-Pad measures in only one scale at a time. *Measurement Scale* in Chapter 3 provides additional information about how scale selection affects coordinate data.

Send Coordinate Formats From Port A Only Code: PA

Send Coordinate Formats From Port B Only Code: PB

Send Coordinate Formats From Port A and Port B Code: AB

These commands select the communication port that the Digi-Pad uses to transmit coordinate formats. If you are using the TTL interface, Port A must be active. If you are using the current loop interface, Port B must be active. Selecting a port for output does not affect which port may become the command port during Command Mode. RS232C data from other devices is passed through the Digi-Pad regardless of which port sends coordinates.

Read Current Coordinate Code: hex 02

The Read Current Coordinate command may be sent to the Digi-Pad only when it is digitizing and only when the remote request mode has been selected by command RM. The Read Current Coordinate command will be ignored if the Digi-Pad is in Command Mode. Note that this command is not two ASCII characters. It is the one-byte-long STX character, control B.

The Digi-Pad responds to the Read Current Coordinate command by transmitting one format.

Format Selection Commands

ASCII Format Output Code: AS

This command causes formats to be transmitted in ASCII. ASCII Formats may be modified by the Low/High Resolution, Pushbutton, Space, Carriage Return and Line Feed commands or by switch settings.

Binary Format Output Code: BN

This command causes coordinates to be transmitted in either of the two binary formats. Binary formats may be modified by the Low/High Resolution and Pushbutton commands or by switch settings.

Low Resolution Code: LR

This command modifies the ASCII or binary formats. If ASCII formats have been selected, the Low Resolution command causes the least significant digit to represent 0.010 inch or 0.25 millimeter, depending on whether English or metric scale has been selected by command or switch. Both X and Y portions of each ASCII format will be four digits long.

If binary formats have been selected, the Low Resolution command causes formats to be in the low resolution binary format. The least significant bit represents 0.005 inch or 0.125 millimeter, depending on whether English or metric scale has been selected by command or switch.

High Resolution Code: HR

This command modifies the ASCII or binary formats. If ASCII formats have been selected, the High Resolution command causes the least significant digit to represent 0.001 inch or 0.025 millimeter, depending on whether English or metric scale has been selected by command or switch. Both X and Y portions of each ASCII format will be five digits long.

If binary formats have been selected, the High Resolution command causes formats to be in the high resolution binary format. The least significant bit represents 0.001 inch or 0.025 millimeter, depending on whether English or metric scale has been selected by command or switch.

Pushbutton Include Code: PI

Pushbutton Exclude Code: PE

These commands control the presence of pushbutton codes in coordinate formats. When included in ASCII formats, the pushbutton code is an additional character in the format. When included in the binary formats, the pushbutton codes occupy specific bits in the format. Pushbutton codes and where they appear in formats are described in Chapter 3.

When pushbutton codes are excluded from binary formats, the pushbutton bits are set to 0.

Space Include Code: SI

Space Exclude Code: SE

These commands control the presence of a space in ASCII formats. When included, the space is an additional character separating the X and Y components of the coordinate data.

Carriage Return Include	Code: CI
Carriage Return Exclude	Code: CE

These commands control the presence of a carriage return in ASCII formats. When included, the carriage return is an additional character immediately following the least significant digit of Y data.

Line Feed Include	Code: LI
Line Feed Exclude	Code: LE

These commands control the presence of a line feed in ASCII formats. When included, the line feed is an additional character following the carriage return (if carriage return included) or following the least significant digit of Y data (if carriage return not included).

Alarm And Status LED Commands

Enable Alarm	Code: AE
Disable Alarm	Code: AD

These commands enable or disable the audible alarm. When enabled, the alarm provides diagnostic and operating information, and it may also be sounded by remote commands. When disabled, the alarm will not sound in response to local operating conditions, but may be sounded by remote commands. *Digi-Pad Tones And What They Mean* in Chapter 4 provides more information about tones.

Sound Tone 1	Code: T1
Sound Tone 2	Code: T2
Sound Tone 3	Code: T3
Sound Tone 4	Code: T4
Tone Pause	Code: T0

The four Sound Tone commands allow a remote device to sound the Digi-Pad's audible alarm. Tone Pause provides a pause between tones. Tones and pauses are in 1/4 second increments.

Tone commands and pauses are stored in a queue in the order they are received. The queue can hold ten tone or pause commands (overflow is lost). Alarm enable and disable commands are also put into this queue. Tone commands are not affected by the Disable Alarm command, or by switch S3-1.

Turn Status LED On	Code: ON
Turn Status LED Off	Code: OF

These commands control the state of the status LED on 16 Button Cursors.

Diagnostic Commands

Transmit Version Number Code: VR

This command causes the Digi-Pad to determine and transmit the version number of the software currently installed in it.

Transmit Serial Number Code: SN

Certain Digi-Pad OEM configurations may involve inserting a system serial number (up to seven digits) into the Digi-Pad's read-only memory. The serial number is stored as contiguous bytes terminated by a # sign (hex 23). Sending this command causes the processor to read the bytes (not including the #) and transmit the serial number as an ASCII string. If the memory contains no serial number, seven hex FFs are transmitted.

Display Tablet Active Area Size Code: SZ

The Digi-Pad automatically determines the size of the attached tablet's active area when it is turned on or reset. This command may be used to send that information to a another device. The size is encoded as four digits: two digits representing vertical size in inches followed by two digits representing horizontal size in inches. For example, the 11"x17" Digi-Pad would send the digits 1117 in response to this command. The Size command can alert you to certain problems in Digi-Pad operation. Chapter 7 has more information about this.

Read Tablet Diodes Code: RD

This diagnostic command causes the Digi-Pad to examine the attached tablet and send the results to another device for display. For more details on this command, see Chapter 7.

Enable Echo Mode Code: EM

Disable Echo Mode Code: hex 0F

Echo mode allows a remote device to test the interface integrity by having the Digi-Pad echo bytes sent to it. The Enable Echo Mode allows echoing to occur. Any byte will be echoed except the command to Disable Echo Mode (hex 0F).

The one-byte Disable Echo Mode command takes the Digi-Pad out of Echo Mode. The Digi-Pad will also be taken out of Echo Mode by the power-on initialization sequence.

Chapter 6

Using Digi-Pad Options

This chapter describes three Digi-Pad options: 4D option, Pressure Pen option, and GPIB Interface option. Before reading about these options, you should be familiar with basic Digi-Pad configuration and operation, as described in Chapters 1 through 5. With that background, you will be better able to understand and use any options your Digi-Pad may have.

4D Option

4D refers to the four dimensions of information–X, Y, Z and tilt–which this option provides. The X and Y dimensions are, of course, the normal Digi-Pad coordinates. The Z dimension is the on/off action of the stylus when it is pressed toward the tablet. The unusual feature of this option is the tilt information which can be generated and output by the Digi-Pad. The 4D option senses the magnitude and direction of stylus tilt with respect to the tablet's surface.

With the 4D option, the stylus may be used like a joystick, that is, its angles can convey information and control graphic functions. The tilt data could be used to pan, zoom or rotate an image. It could also be used to select color, line width or intensity. Added to the XY position information, tilt increases the Digi-Pad's usefulness in a graphic system.

The 4D option is made possible by factory-installed hardware and firmware. Any Digi-Pad may be modified to generate tilt data. The option works with all Digi-Pad tablet sizes, and requires a standard stylus. The 4D option is controlled only by remote commands, not switches, so a controlling device (such as a terminal or computer) is required to use it. The controlling device must communicate with the Digi-Pad through the RS232 or optional GPIB ports.

Stylus tilt data is generated only when the Digi-Pad is operating in tilt mode. Tilt mode is invoked by a command and may be used at the same time as any of the digitizing modes, such as point mode, line mode and so on.

Tilt is encoded into two numbers. One number represents tilt with respect to the X axis, and the other represents tilt with respect to the Y axis. Each tilt number may vary from 0_{10} (when the stylus is tilted fully toward the axis origin) to 63_{10} (when the stylus is tilted fully away from the axis origin). When the stylus is vertical, the tilt number is 32_{10}. This is illustrated in Figure 6.1.

Formats are modified when tilt mode is operating. Tilt mode may be used with either ASCII or binary formats. With tilt mode enabled, ASCII formats are preceded by two bytes of tilt data. Binary formats are followed by two bytes of tilt data. Tilt data is always encoded in binary form, so that with ASCII formats, tilt data must be decoded before it can be displayed. Figures 6.2, 6.3 and 6.4 show the two tilt data bytes that would precede ASCII formats, and follow the binary formats.

4D commands allow you to enable and disable tilt output, set a vertical reference point, and scale the tilt data. Here are descriptions of those commands:

Enable Tilt Mode **Code: TE**

This command causes the Digi-Pad to generate tilt data and include it with coordinate formats.

Disable Tilt Mode **Code: TD**

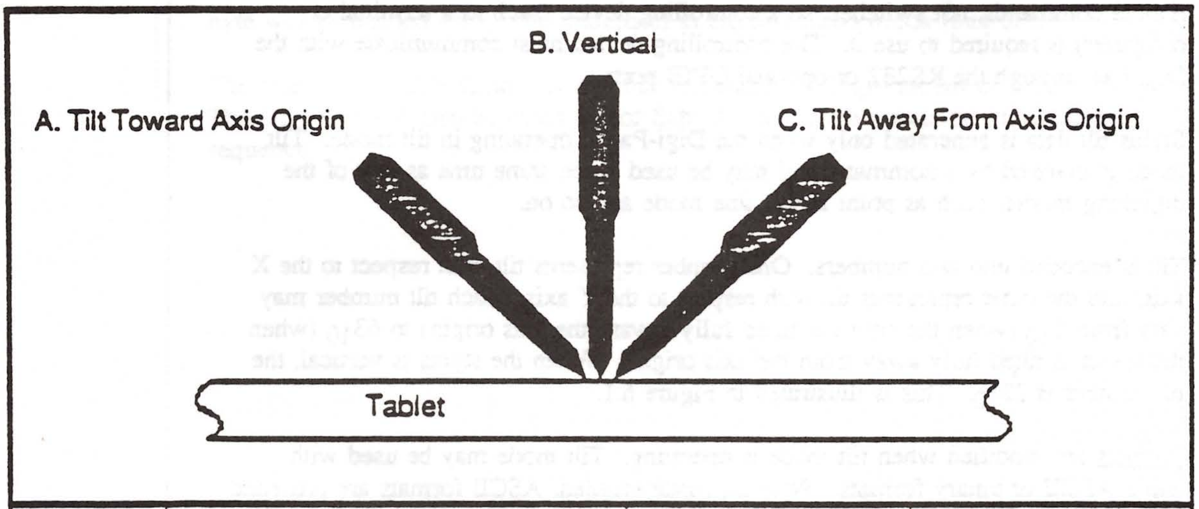
This command turns off tilt mode.

Set Vertical Point **Code: VP**

Before using tilt mode, you must define one stylus postion as vertical. Sending the Vertical Point command causes the last stylus tilt position before entering command mode to be made the vertical position. While the stylus would normally be perpendicular to the tablet for this position, it need not be.

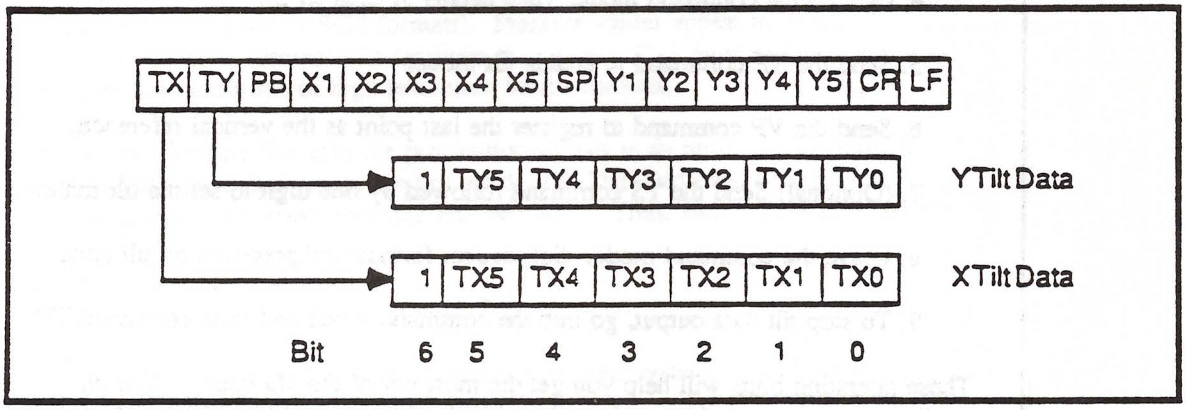
Tilt Scale **Code: TS**

This command permits scaling the 6 bits of tilt resolution for varying degrees of sensitivity. After sending the TS command, the Digi-Pad prompts for a one digit scale value. Valid scale values range from 0 to 9. Zero is the maximum sensitivity, causing full scale tilt output with small stylus deflection. Nine gives the least sensitivity, with large stylus deflections causing only a small change in tilt data. The default scale setting is 3.



Position	Condition	Data (in decimal)	Data (in binary)
A	Full Scale Minimum	0	000000
B	Vertical	32	100000
C	Full Scale Maximum	63	111111

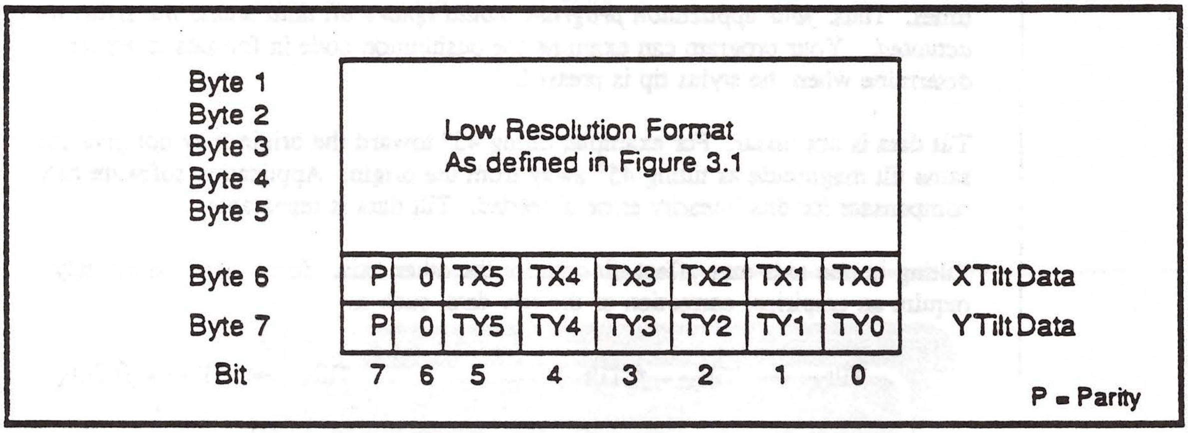
Figure 6.1 - Tilt Data Range And Its Relation To Stylus Position



TX	TY	PB	X1	X2	X3	X4	X5	SP	Y1	Y2	Y3	Y4	Y5	CR	LF

Bit	6	5	4	3	2	1	0	
	1	TY5	TY4	TY3	TY2	TY1	TY0	YTilt Data
	1	TX5	TX4	TX3	TX2	TX1	TX0	XTilt Data

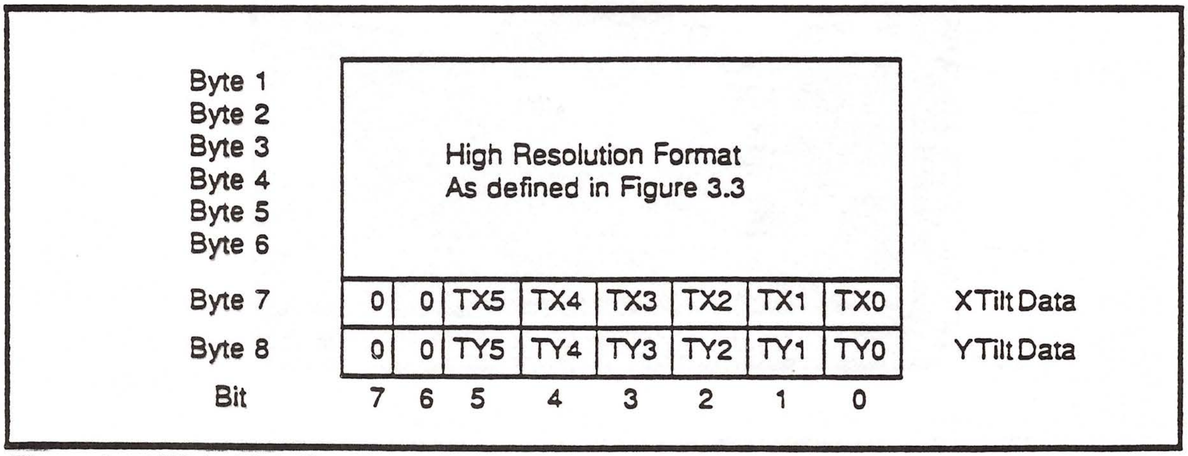
Figure 6.2 - Tilt In ASCII Formats



Byte 1 Byte 2 Byte 3 Byte 4 Byte 5	Low Resolution Format As defined in Figure 3.1								
Byte 6	P	0	TX5	TX4	TX3	TX2	TX1	TX0	XTilt Data
Byte 7	P	0	TY5	TY4	TY3	TY2	TY1	TY0	YTilt Data
Bit	7	6	5	4	3	2	1	0	

P = Parity

Figure 6.3 - Tilt In Low Resolution Binary Formats



Byte 1 Byte 2 Byte 3 Byte 4 Byte 5 Byte 6	High Resolution Format As defined in Figure 3.3								
Byte 7	0	0	TX5	TX4	TX3	TX2	TX1	TX0	XTilt Data
Byte 8	0	0	TY5	TY4	TY3	TY2	TY1	TY0	YTilt Data
Bit	7	6	5	4	3	2	1	0	

Figure 6.4 - Tilt In High Resolution Binary Formats

Follow these steps to use the 4D option:

1. Configure your Digi-Pad and connect it to a device, such as a terminal or computer, that can send commands to it. Chapters 1 through 3 contain information about how to set up the Digi-Pad.
2. Apply power to the system. Assure that the Digi-Pad is transmitting coordinate formats.
3. Place the stylus on the tablet in the tablet's active area. Position the stylus perpendicular to the tablet (or in some other reference position), then press the stylus toward the tablet to digitize one point.
4. Go into the command mode. (See details in Chapter 5.)
5. Send the TE command to enable tilt mode.
6. Send the VP command to register the last point as the vertical reference.
7. (Optional) Send the TS command followed by one digit to set the tilt scale.
8. Leave the command mode. Subsequent formats are preceded by tilt data.
9. To stop tilt data output, go into the command mode and send command TD.

These operating hints will help you get the most out of the 4D option. The tilt reading is sensitive to changes in stylus altitude above the tablet. This is of concern when operating in continuous mode, because coordinate formats are being sent at all times. Thus, *your application program should ignore tilt data unless the stylus tip is actuated.* Your program can examine the pushbutton code in formats to assure determine when the stylus tip is pressed.

Tilt data is not linear. For example, tilting 45° toward the origin may not give the same tilt magnitude as tilting 45° away from the origin. Application software can compensate for this linearity error if needed. Tilt data is repeatable.

Tilting in one axis may affect tilt data for the other axis. Some applications may require an empirical correction of the raw data, such as:

$$\mathrm{Tilt}_X \leftarrow \mathrm{Tilt}_X + f(\mathrm{Tilt}_Y) \qquad \mathrm{Tilt}_Y \leftarrow \mathrm{Tilt}_Y + f(\mathrm{Tilt}_X)$$

Pressure Pen Option

The Pressure Pen is a separate accessory which may be attached to any Digi-Pad. It differs from a regular stylus in that pressure on its tip provides a range of values (from 0 to 31), instead of just 0 and 1 (representing off and on) for a regular stylus. The pressure pen includes a control box, as pictured in Figure 6.5.

The Pressure Pen may be used to control a variety of graphic functions. Some examples are: selecting color, selecting line width, and selecting intensity. Using the Pressure Pen to control such functions is convenient, since the pressure-activated stylus is right in your hand.

The pressure values are encoded as five bits of data in binary formats (the Pressure Pen cannot be used with ASCII formats). Pressure values appear in place of pushbutton codes in formats. To facilitate this, switch S2-1 must be ON. You may use either low resolution or high resolution binary formats.

Because the Pressure Pen uses the pushbutton signals in an unusual way, most of the Digi-Pad's digitizing modes are not valid. The Digi-Pad must be set for continuous mode for proper Pressure Pen operation. Thus, switch S3-4 must be ON.

Follow these steps to set up the Pressure Pen:

1. Configure your Digi-Pad and connect it to your system. See Chapters 1 and 2 for details.

2. Attach the Pressure Pen to Digi-Pad connector J2.

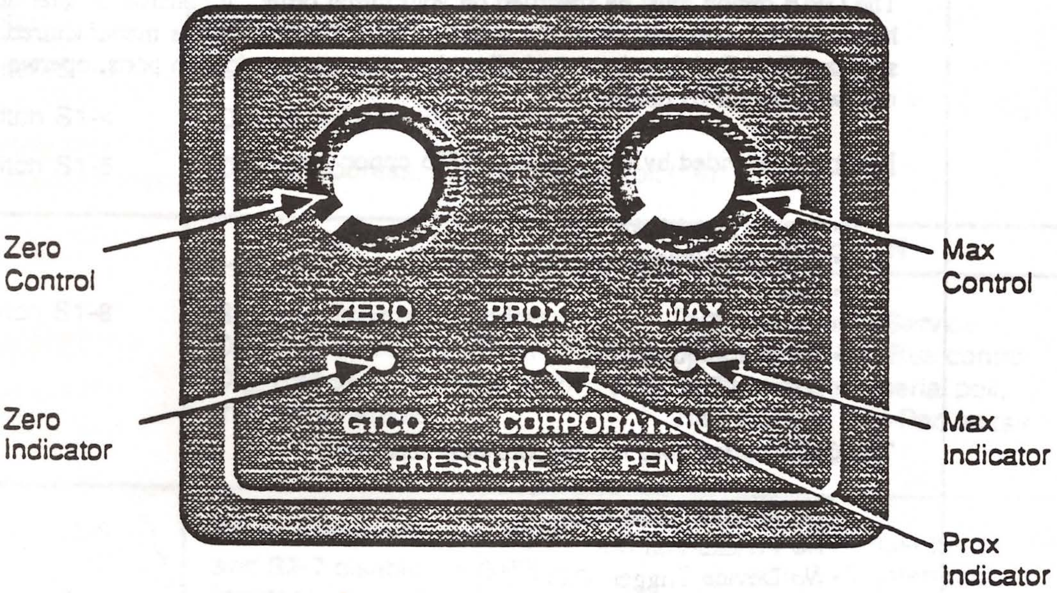


Figure 6.5 - Pressure Pen Control Box

3. Set the Digi-Pad switches according to the instructions in Chapters 3 and 4. Additionally, you should make the following switch settings:
    - Set switch S2-1 ON to include pushbutton codes in formats
    - Set switch S2-5 OFF to select low resolution or ON to select high resolution
    - Set switch S3-4 ON to select continuous mode
    - Set switch S3-5 OFF to select 5 button cursor
    - Set switch S3-7 ON to select binary formats

4. Apply power to the system.

5. Rotate both knobs on the Pressure Pen box fully counter-clockwise (see Figure 6.5).

6. Hold the stylus in the air with nothing touching its tip. Turn the Zero knob on the box slowly clockwise until the Zero indicator (green) just turns on.

7. Press the stylus tip on any surface so that it is inside the barrel as far as it can go. Rotate the Max knob slowly clockwise until the Max indicator (yellow) just turns on. Repeat steps 6 and 7 if necessary.

8. Place the stylus in the active area. The indicator marked PROX on the Pressure Pen box is on when the stylus is within the tablet's active area. The Digi-Pad should now be generating formats. By examining the pushbutton code bits in the formats, you will find the pressure information.

GPIB Interface Option

The Digi-Pad's GPIB Interface option provides bidirectional communication with other GPIB devices. The interface conforms to the physical, electrical and operationa requirements of ANSI/IEEE-488 (1978). A full discussion of GPIB is beyond the scope of this manual. If you need to know more about GPIB, reference materials are available from other sources.

The GPIB option must be specified on your initial order. It consists of interface hardware and operating firmware installed when the Digi-Pad is manufactured. All standard Digi-Pad functions, including the other communication ports, operate in a unit with the GPIB option.

Functions provided by the Digi-Pad GPIB option are:

- Source Handshake (SH)
- Acceptor Handshake (AH)
- Talker (T)
- Listener (L)
- Service Request (SR)
- Device Clear (DC)

The GPIB option *does not* support these functions:

- *No* Remote Local (RL)
- *No* Parallel Poll (PP)
- *No* Device Trigger (DT)
- *No* Controller (C)

Switches are used to set initial operating conditions with GPIB, just as they are under standard Digi-Pad operation. The GPIB option is activated by two switches, S2-6 and S2-7. When GPIB is active, certain of the Digi-Pad's switches take on new meanings. Figure 6.6 shows the switches that have altered functions under GPIB.

Cabling for GPIB is attached to J4 on the Digi-Pad's rear panel. J4 is a standard GPIB device connector. GPIB cables used with the Digi-Pad must be shielded.

Commands may be sent to the Digi-Pad through the GPIB interface by using the following sequence of steps:

1. Address the Digi-Pad as a Listener.
2. Send a Control A (hex 01) to the Digi-Pad to invoke command mode.
3. Send two-character commands, each terminated with a Return (hex 0D).
4. After the last command has been sent, send an Escape (hex 1B) to leave the command mode.
5. Address the Digi-Pad as a Talker.

You can find more details about using commands in Chapter 5.

<table>
<tr><th>Switch</th><th colspan="2">Function</th></tr>
<tr><td>Switch S1-1</td><td colspan="2">Device Address, least significant bit (1)</td></tr>
<tr><td>Switch S1-2</td><td colspan="2">Device Address (2)</td></tr>
<tr><td>Switch S1-3</td><td colspan="2">Device Address (4)</td></tr>
<tr><td>Switch S1-4</td><td colspan="2">Device Address (8)</td></tr>
<tr><td>Switch S1-5</td><td colspan="2">Device Address, most significant bit (16)</td></tr>
<tr><td></td><td>Switch OFF</td><td>Switch ON</td></tr>
<tr><td>Switch S1-8</td><td>Bus controller must address Digi-Pad as a talker. Then Digi-Pad sends formats when they are available.</td><td>Digi-Pad asserts Service Request (SRQ). Bus controller must perform serial poll, then address Digi-Pad as talker to transfer data.</td></tr>
<tr><td>Switch S2-6
Switch S2-7</td><td>Other combinations of S2-6 and S2-7 disable the GPIB interface.</td><td>S2-6 and S2-7 must be ON to activate GPIB interface.</td></tr>
</table>

Figure 6.6 - GPIB Switch Settings

Output from the Digi-Pad may be handled in either of two ways, as selected by switch S1-8: with the Digi-Pad as a Talker, or with the Digi-Pad responding to a Serial Poll.

- In Talker mode, the bus controller must address the Digi-Pad as a Talker. Coordinate formats will then be sent through the GPIB interface according to Digi-Pad conventions. For example, if the Digi-Pad is in point mode, one format will be sent when the stylus or a cursor button is pressed. If the Digi-Pad is in continuous mode, a stream of coordinates will be sent when the stylus or cursor is in the active area.

- In Serial Poll mode, the Digi-Pad asserts the SRQ (service request) line on the bus when it has data to send. The bus controller then polls each device on the bus to determine which device made the request. This is done by the bus controller first issuing a Serial Poll Enable command and then addressing each device as a talker. In response to the serial poll, the Digi-Pad sends a hex 40 when it has data available. The bus controller then issues a Serial Poll Disable command and addresses the Digi-Pad as a Talker. The Digi-Pad then sends its data. The cycle is repeated when the Digi-Pad is again ready to send data.

Formats can be any of the coordinate formats available on the Digi-Pad. Chapter 3 describes formats and how to select them with switches. Formats can also be selected by commands, as discussed in Chapter 5.

Follow these steps to set up the Digi-Pad for GPIB operation:

1. Attach a shielded GPIB cable to J4.
2. Set switches S2-6 and S2-7 to their ON positions to activate the GPIB port.
3. Select a device address for the Digi-Pad. Convert the address to binary notation and set Switches S1-1 through S1-5 accordingly.
4. Decide whether you want the Digi-Pad to operate as a full-time talker or initiate serial poll. Set Switch S1-8 appropriately.
5. Select a coordinate format and set the Digi-Pad switches for that format (see Chapter 3 for more details about formats).
6. Configure and program your GPIB computer to accept Digi-Pad formats.
7. Apply power to the Digi-Pad and the other components in your GPIB system. Digi-Pad operation now follows the descriptions in Chapter 4.

Chapter 7

Digi-Pad Reference

This chapter contains miscellaneous technical information about the Digi-Pad.

General Theory Of Operation

The Digi-Pad uses an electromagnetic principle, which involves measuring the time for an electromagnetic wavefront to travel down an axis, to produce absolute coordinate information. The wavefront is generated by switching, at a precisely controlled rate, a current in a precision array of parallel conducting wires in the tablet. The tablet contains two sets of parallel wires, one for the X axis and one for the Y axis.

An electronic timer begins counting when the wavefront starts across an axis. A coil inside the stylus or cursor senses the passage of the wavefront and stops the timer at that instant. There is linear relationship between distance and the time of arrival of the wavefront at the coil. The count is converted to distance for further processing.

A microprocessor controls the Digi-Pad's complex internal operations. It performs mathematical operations on the coordinate data, assembles the data into formats, and send the formats out through the Digi-Pad's communication ports. It also responds to commands from external devices, performs thorough tests of the Digi-Pad's operation, and alerts the user when it finds a problem.

Digi-Pad circuits are protected by patents.

Technical Specifications

Accuracy	Standard:	±0.010 inch
	Optional:	±0.005 inch
	Optional:	±0.003 inch
	L Series Tablets:	±0.020 inch
Resolution:	0.001 inch	
Coordinate Origin:	Lower left corner	
Operating Environment:	Temperature:	5° to 46° Celsius
	Humidity:	10% to 90%, non-condensing
	Altitude:	2150 meters (7000 feet)
Storage Environment:	Temperature:	-20° to 60° Celsius
	Humidity:	5% to 99%, non-condensing
	Altitude:	9000 meters (30,000 feet)

Interface Specifications

Digi-Pad serial port pin definitions are shown in Figure 7.1. Figure 7.2 shows the functional operation of the Digi-Pad's serial ports.

Hardware Flow Control

RS232C hardware flow control is enabled by switch S3-8 being ON. With hardware flow control enabled, the Digi-Pad monitors certain input lines on Ports A and B. The states of these input lines are passed from one port to the corresponding output lines on the other port. Figure 7.3 shows how the control lines are related. The Digi-Pad obeys the states of the input lines when hardware flow control is enabled.

With hardware flow control disabled, the Digi-Pad ignores the flow control input lines on Ports A and B. The flow control output lines on Ports A and B are held on.

Software Flow Control

The Digi-Pad responds to XOFF (hex 13) and XON (hex 11) received through the RS232C data input lines of either Port A or Port B. The Digi-Pad recognizes these ASCII control characters when it is digitizing or when it is in command mode. Software flow control is active at all times.

- XOFF: This flow control character is passed through to the other port as part of the bidirectional protocol. An XOFF inhibits output at the port on which it was received. Transmission ceases after the current byte is sent. Coordinates may be truncated.

J5 - RS232C Port A

Pin	RS232C Function	Digi-Pad Function
1	Chassis ground	Chassis ground
2	Transmitdata	Data output
3	Receive data	Data input
4	Request to send	Flow control output
5	Clear to send	Flow control input
6	Data set ready	Flow control input
7	Signal ground	Signal ground
8	Carrier detect	To Port B, pin 8 (1K ohms to +12 volts)
9	–	Positive test voltage (+12 volts via 1K ohms)
10	–	Negative test voltage (-12 volts via 1K ohms)
11	–	TTL data output
20	Data terminal ready	Flow control output

J6 - RS232C Port B

Pin	RS232C Function	Digi-Pad Function
1	Chassis ground	Chassis ground
2	Transmitdata	Data input
3	Receive data	Data output
4	Request to send	Flow control input
5	Clear to send	Flow control output
6	Data set ready	Flow control output
7	Signal ground	Signal ground
8	Carrier detect	To Port A, pin 8 (1K ohms to +12 volts)
9	–	Positive test voltage (+12 volts via 1K ohms)
10	–	Negative test voltage (-12 volts via 1K ohms)
17	–	Current loop return
20	Data terminal ready	Flow control output
24	–	Current loop data output

Figure 7.1 - Pin Definitions For Digi-Pad RS232C Ports

- XON: This flow control character is passed through to the other port as part of the bidirectional protocol. It restores data output from a port previously inhibited by XOFF. Data starts at the beginning of the next available format.

Current Loop Output

The current loop output on Port B duplicates the serial output of that port. Output will be inhibited by RS232C hardware and software flow control signals as described above. Baud rates and coordinate formats as defined for RS232C are available on the current loop. No current loop input is provided.

Current loop drive: 20 milliamps nominal, 30 milliamps maximum.

Serial TTL Output

The serial TTL output on Port A duplicates the serial output of that port. Output will be inhibited by RS232C hardware and software flow control signals as described above. Baud rates and coordinate formats as defined for RS232C are available on the TTL line. No TTL input is provided.

TTL drive: 10 standard TTL loads.

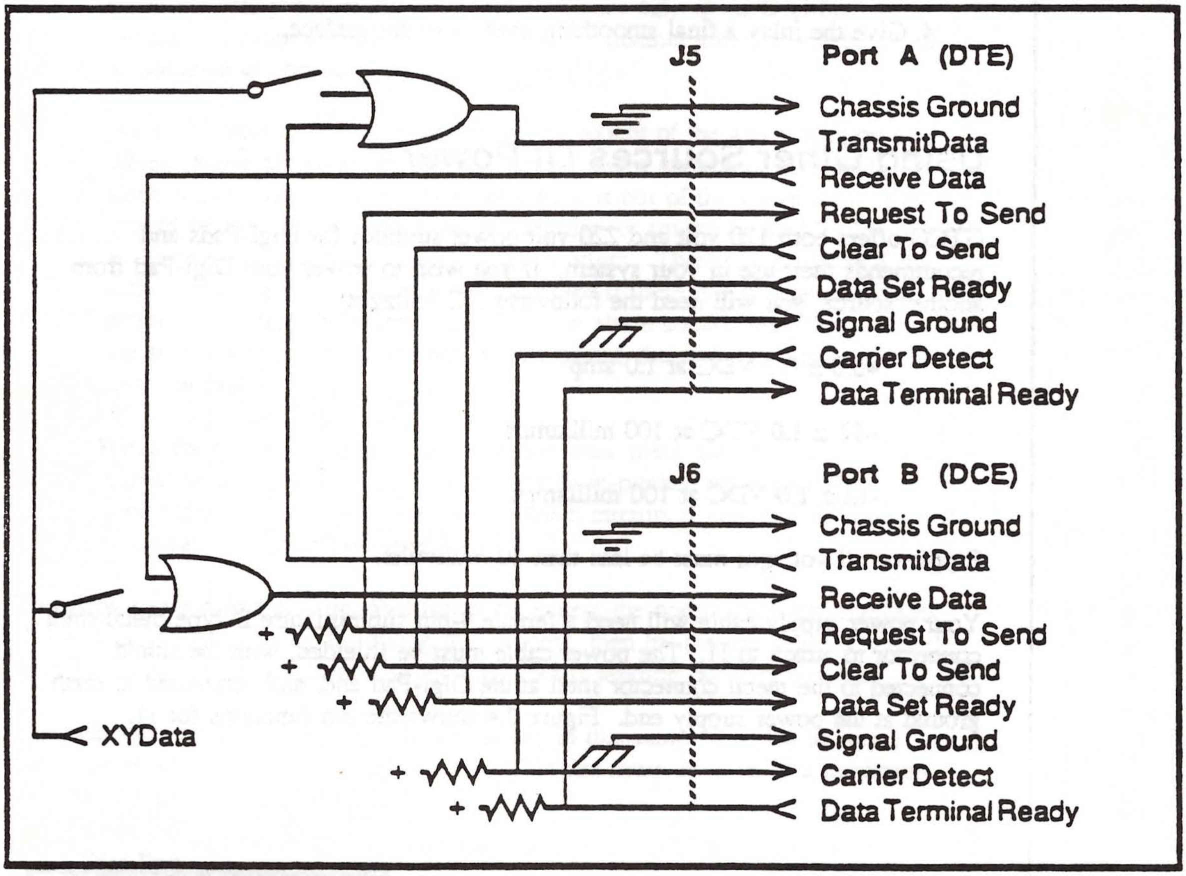


Figure 7.2 - Simplified Functional Diagram Of RS232C Ports A And B

Digi-Pad monitors the states of these lines...		...and passes them through...	...to these lines		RS232C Function
Port	Pin		Port	Pin	
A	5	→	B	5	CTS
A	6	→	B	6	DSR
B	4	→	A	4	RTS
B	20	→	A	20	DTR

Figure 7.3 - Hardware Flow Control

Changing Inlays On Small Digi-Pads

Most of the tablet surface on 11"x11" and 11"x17" Digi-Pads is covered by a removable plastic inlay. You might want to replace this inlay if it becomes worn or damaged, or if you have a pre-printed application-specific inlay to use in its place. Here is how to change the inlay:

1. Beginning at a corner, peel up the old inlay.
2. Peel back a 4" width of the release paper from the back of the new inlay. Carefully align this edge with the recess in the tablet top. Press this edge in place.
3. Adhere the inlay further by peeling back the release paper small distances (2"-3" at a time) and pressing the freshly exposed adhesive in place. Avoid trapping air under the inlay.
4. Give the inlay a final smoothing over its entire surface.

Using Other Sources Of Power

GTCO offers both 120 volt and 220 volt power supplies for Digi-Pads and recommends their use in your system. If you wish to power your Digi-Pad from another source, you will need the following DC voltages:

+5.0 ± 0.1 VDC at 1.0 amp

+12 ± 1.0 VDC at 100 milliamps

-12 ± 1.0 VDC at 100 milliamps

Ripple on all voltages must be less than 30 millivolts.

Your power supply cable will need a female 9-pin subminiature D type metal shell connector to attach to J1. The power cable must be shielded, with the shield connected to the metal connector shell at the Digi-Pad end, and connected to earth ground at the power supply end. Figure 7.4 shows the pin functions for J1.

J2 - Power	
Pin	Function
1	+5 volts
2	+5 volts
3	Not used
4	+12 volts
5	Not used
6	-12 volts
7	Power ground
8	Power ground
9	Chassis ground

Figure 7.4 - Power Connector

Troubleshooting The Digi-Pad

If you suspect that your Digi-Pad is not operating correctly, the following procedure will help you to determine for certain whether the Digi-Pad is at fault.

1. Set Switch S2-8 ON (alarm enabled) and set Switch S3-4 OFF (point/line mode).
2. Set Switch S3-5 OFF if you have a stylus, 1 button cursor, 4 button cursor or 5 button cursor. Set Switch S3-5 ON if you have a 16 button cursor.
3. Apply power to the Digi-Pad, or press the Reset button on the rear panel.
4. Listen to the tones generated by the Digi-Pad (Figure 4.5 will help you interpret the tones). Four high-pitched tones (tone 4) indicate the Digi-Pad has examined and approved the operation of several key subsystems. Other tones indicate problems as described in Figure 4.5. If the Digi-Pad detects certain catastrophic failures, as indicated by distinct tones, it will be unable to continue to normal digitizing.
5. Use your stylus or cursor to determine the extent of the active area on the tablet. Move the stylus or cursor over the entire surface of the tablet. The alarm will sound when the stylus or cursor is out of the active area. You should find the active area to be rectangular (or square on an 11"x11" model) and located about equally from all tablet edges. There is a problem if the active area is grossly offset on the tablet, or if there is a spot within the active area where the alarm sounds. If the alarm sounds regardless of whether the stylus or cursor is in the active area or not, the stylus or cursor is most likely at fault.
6. While the stylus or cursor is in the active area, press the stylus tip or press a cursor button. You should hear one medium-pitched tone (tone 3). There is a problem with the switch or switch detect circuits if you hear no tone, or if you hear more than one tone.

The steps above check all Digi-Pad functions except the communication interfaces. If you find no problems by following this process, then try the test setup described next. This test can help assure that the Digi-Pad is sending out data correctly.

You will have to set all the Digi-Pad's switches in this setup. The list in step 3 below gives you specific settings to make. This test setup consists of a minimum number of components:

- Digi-Pad
- Stylus or cursor
- Digi-Pad power supply
- RS232C cable
- RS232C terminal, or computer with RS232C port and communications software

The RS232C cable must have at least the following wires between its connectors: pins 1-1, pins 2-2, pins 3-3, pins 7-7. Depending on the terminal or computer, other connections may be needed (sorry, we don't know which ones, if any, but the terminal or computer user manual should advise you about this).

(Instructions continued on next page...)

1. Connect everything together (see Figure 7.5).

   - Connect power supply to the Digi-Pad
   - Connect stylus or cursor to the Digi-Pad
   - Connect the RS232C cable between Digi-Pad J6 (Port B) and the terminal/computer

2. Set the terminal/computer communications as follows:

• Baud:	1200
• Data bits:	8
• Parity:	none
• Stop bits:	1

3. Set the Digi-Pad switches as follows:

• S1-1	ON	|
• S1-2	ON	| 1200 baud
• S1-3	ON	|
• S1-4	OF	|
• S1-5	OFF	Parity: none
• S1-6	OFF	
• S1-7	OFF	1 stop bit
• S1-8	ON	8 data bits
• S2-1	ON	Include pushbutton code
• S2-2	ON	Include space
• S2-3	ON	Include carriage return
• S2-4	ON	Include line feed
• S2-5	ON	High resolution
• S2-6	OFF	| Ports A and B active
• S2-7	OFF	|
• S2-8	ON	Alarm enabled
• S3-1	OFF	
• S3-2	OFF	| 200 coordinates per second digitizing rate
• S3-3	ON	|
• S3-4	OFF	Point/line mode
• S3-5	OFF	Stylus, 1, 4, or 5 button cursor (or ON for 16 button cursor)
• S3-6	OFF	Inch scale
• S3-7	OFF	ASCII coordinates
• S3-8	OFF	No hardware flow control

4. Apply power to the terminal/computer and Digi-Pad.

5. Place the stylus or cursor in the tablet's active area. Press the stylus or a cursor button several times.

6. If the Digi-Pad is properly sending data, and if the terminal/computer is properly receiving data, you will see several coordinate formats on the terminal/computer screen.

If you still have a problem with your Digi-Pad's operation, contact GTCO Customer Service at (301) 279-9550 between 9 am and 5 pm eastern time.

Interpreting SZ And RD Command Responses

The Digi-Pad provides two advanced diagnostic indicators that may help identify particular operating problems. To use the results of these tests requires technical information beyond the scope of this manual.

SZ Command

The Display Tablet Active Area Size (code SZ) command may be used to find the size of the Digi-Pad tablet's active area. In a normal response to the command the Digi-Pad sends four digits encoding the size. For example, a Digi-Pad with a 24"x36" tablet would send the digits 2436.

Digi pad 5
36 48

In an abnormal response to the SZ command, the Digi-Pad sends one of the following messages: NO TABLET DETECTED, TABLET SIZE UNKNOWN or TABLET MISSING LINE. These indicate at least one of the following problems:

A. Tablet cable disconnected from controller
B. Tablet cable connector reversed at tablet end
C. Bad tablet cable connector
D. Bad tablet wire or diode
E. Bad current source or current sink IC on controller
F. Bad current source or current regulator on controller
G. Bad current sensing circuit on controller
H. Non-standard tablet type

If the Digi-Pad senses any of these conditions when power is applied, or when it is reset, it will sound paticular alarm sequences (See Figure 4.5). If the tablet is known to be a standard type, and the interconnections between tablet and controller are found to be o.k., then the RD (next page) command may help narrow the possibilities.

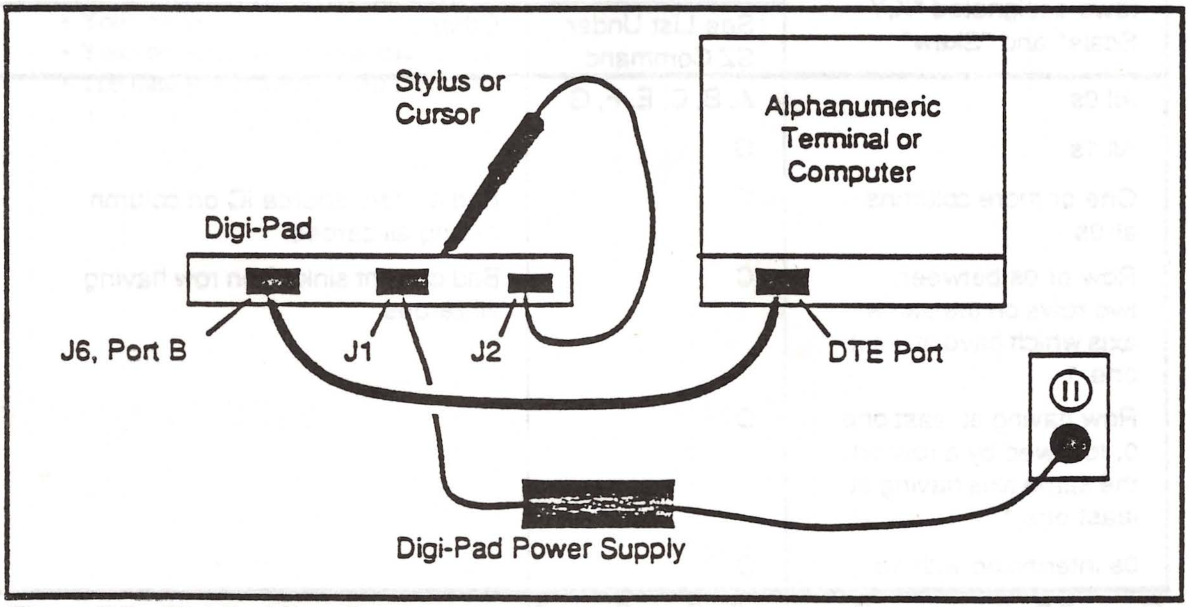


Figure 7.5 - Digi-Pad Test Setup

RD Command

When the Digi-Pad receives a Read Tablet Diodes command (code RD), it scans the attached tablet line by line and sends a report of its findings out through the Command Port. The report is a series of displayable ASCII characters. A functioning line is represented by a 1. A 0 represents a non-functioning line, or more commonly a non-existent line (since the tablet will have only a subset of all possible lines).

Figure 7.6 shows a normal response to the RD command for an 11"x11" Digi-Pad. Other sizes will produce similar displays, with rows of 1s normally beginning at rows X0 and Y0. The rows designated "X,Y Scale" and "Skew" may normally contain random bits. Figure 7.7 lists symptoms which might be seen in an abnormal RD display and what they indicate.

Columns Connected To Source Lines																Rows Connected To Sink Lines
0	0 1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	X0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	X1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X6
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X7
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Y0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	Y1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Y2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Y3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Y4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Y5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X,Y scale
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Skew

Figure 7.6 - Read Diode Display Example (11"x11" Tablet)

Observation (other than rows designated "X,Y Scale" and "Skew"	Possible Causes	
	See List Under SZ Command	Other
All 0s	A, B, C, E, F, G	
All 1s	G	
One or more columns all 0s	C	Bad current source IC on column having all zeroes
Row of 0s between two rows on the same axis which have at least one 1	C	Bad current sink IC on row having all zeroes
Row having at least one 0, followed by a row on the same axis having at least one 1	D	
0s intermixed with 1s	D	

Figure 7.7 - Symptoms Revealed By Read Diode Display

Radio And Television Interference

Digi-Pad Models DP5A-1111A and DP5A-1117A generate and use radio frequency energy and if not installed and used in accordance with these instructions, may cause interference to radio and television reception. The DP5A-1111A and DP5A-1117A have been tested with shielded interconnecting cables and found to comply with the limits for a Class B computing device in accordance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the Digi-Pad off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the digitizer with respect to the receiver
- Move the digitizer away from the receiver
- Plug the digitizer into a different outlet so that digitizer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems".

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

Obtaining Digi-Pad Schematics

Schematics are available for the Digi-Pad controller, tablets, and accessories. You may request one set by writing to GTCO's Marketing Department. Your request should include the following information:

- Your name
- Your organization's name and address
- The date you received your Digi-Pad

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Digi-Pad Switch Settings

	Baud Rate						
	300	600	1200	2400	4800	9600	19200
Switch S1-1	OFF	ON	ON	ON	ON	OFF	ON
Switch S1-2	OFF	OFF	ON	OFF	ON	OFF	OFF
Switch S1-3	ON	ON	ON	OFF	OFF	ON	ON
Switch S1-4	OFF	OFF	OFF	ON	ON	ON	ON

	Switch OFF	Switch ON
Switch S1-5	Parity disabled	Parity enabled
Switch S1-6	Parity odd	Parity even
Switch S1-7	1 stop bit	2 stop bits
Switch S1-8	7 bit character	8 bit character
Switch S2-1	No pushbutton code	Include pushbutton code
Switch S2-2	No space	Include space (ASCII only)
Switch S2-3	No carriage return	Include carriage return (ASCII)
Switch S2-4	No line feed	Include line feed (ASCII only)
Switch S2-5	Low res ASCII if S3-7 is OFF Low res binary if S3-7 is ON	High res ASCII if S3-7 is OFF High res binary if S3-7 is ON

	Active Serial Port			
	A and B	A Only	B Only	GPIB Port*
Switch S2-6	OFF	ON	OFF	ON*
Switch S2-7	OFF	OFF	ON	ON*

	Switch OFF	Switch ON
Switch S2-8	Alarm disabled	Alarm enabled
Switch S3-1	Not used	Not used

	Rate, Coordinates/Second			Incremental Mode
	25	100	200	
Switch S3-2	OFF	ON	OFF	ON
Switch S3-3	OFF	OFF	ON	ON

	Switch OFF	Switch ON
Switch S3-4	Point/line mode	Continuous mode
Switch S3-5	Stylus, 4B or 5B cursor	16B cursor
Switch S3-6	Inch scale	Metric scale
Switch S3-7	ASCII formats	Binary formats
Switch S3-8	No hardware flow control	Hardware flow control enabled

*With the GPIB Port active, these switches take on new meanings: S1-1, S1-2, S1-3, S1-4, S1-5 and S1-8. See Digi-Pad User's Manual, Chapter 6.

	S1	S2	S3
1	−	+	−
2	−	+	−
3	+	+	+
4	+	+	−
5	+	+	−
6	−	−	−
7	−	−	−
8	+	−	−

TOPO

Digipad Switch
settings

6/4/95

Works for

Topo

9600, 0, 8, 1